AGROLAND: The Agricultural Sciences Journal
Vol. 9, No. 1 June (2022), 59 - 65
P-ISSN : 2407- 7585 & E-ISSN : 2407- 7593, Published by Tadulako University

Original Research **Open Access**

APPLICATION OF WATER PROVISION ON THE GROWTH AND PRODUCTION OF SOYBEAN *(Glycine max* L)

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Submit: 10 June 2022, Revised: 21 June 2022, Accepted: June 2022
DOI : https://doi.org/10.22487/agroland.v9i1.1323

ABSTRACT

The most essentials factor underlying water management are the characteristics of plants to water requirements, the amount of water given, the irrigation methods, and the characteristics of the soil in storing water. The research purpose is to identify and determine the best irrigation method, which can increase the growth and production of soybean plants. Knowing the best method of giving water/irrigation that can maintain soil moisture for soybean plants. The experiment used a randomized block design consisting of four treatments, namely: Control, Sprinkle Method, furrow method, and Flood method. Each treatment was repeated three times. The data were analyzed statistically and if there was a significant effect, it would be continued with an test of honestly significant difference. The results showed that the Flood method gave the best effect on almost all parameters of growth and production observations and the highest yield for production per hectare was 4.32 tons.

Keywords*:* Soybean, Sprinkle method, Furrow method, and Flood method.

INTRODUCTION

Being one of the best vegetable protein sources for Indonesian people in general. Soybean is consumed in the forms of tempeh, and tofu which is the Indonesian main dish. Other forms of soy products are soy sauce, tauco, and soy milk. Murtiati S, dkk (2016). This product is consumed by most the Indonesian people. The need for soybeans continues to increase from year to year along with the increase in population. The annual demand for soybeans is ±2,200,000 tons of dry beans. Ironically, the fulfillment of soybean needs of 1.5 million tons (67.99%) must be imported from abroad. This happens because domestic production is not able to meet the demand for tempe and tofu producers. SUSENAS 2015 released by BPS, the average consumption of tempeh per person per year in Indonesia is 6.99 kg and tofu 7.51 kg (Riniarsi, 2016).

Being renowned as the largest tempeh producer in the world Indonesia and become the largest soybean market in Asia. Turns out, Indonesia's soybean domestic production experienced a

moderate drop in 2020 reaching 613.000 tons, it is also predicted will fall again by 3,05% to 594.600 tons in 2022. So, to meet the shortage of needs, it must be imported (BPS, 2021). One way to improve soybean production is to increase the harvested area which can be achieved by extensification to dry land areas which are very large in Indonesia, this can be achieved if water management on the land can be carried out optimally. Considering that optimal plant growth and yield can be achieved if water as the most important factor in plant growth can be available in sufficient quantities according to plant needs, one of the solutions offered in this study is to find the right water management system to meet the water needs of soybean plants.

The increase in national soybean production could be done through the expansion of the planting area and an improvement in production per unit area. For the optimal area, the expansion of the planting area is constrained by competition with other commodities such as rice, so farmers are more interested in growing rice. Meanwhile, for sub-optimal areas, larger technology and capital inputs are required, so that is also an obstacle in its application (Lisa Mawarni, 2011).

The Lack of basic information on crop water requirements in tropical conditions is one of the reasons for inefficient water use and inadequate irrigation management (Evandro et al, 2019). The main consequences of changing water resources for agricultural production include: (i) increased water demand in all regions due to increased crop evapotranspiration in the face of rising temperatures; (ii) increasing water shortages, particularly in the hot summer months, increasing the demand for water for irrigation (iii) decreasing water quality due to higher water temperatures and lower runoff rates in some areas (Iglesias & Garrote, 2015).

The effort that can be made to meet the availability of plant water is irrigation. According to Sulistyono dan Isnawati (2016), more irrigation water intervals can increase production in plants such as green beans. The irrigation provided to these plants maintains the temperature and humidity of the soil so that it supports plant growth Lakew *et al*. (2014) reported that innovative irrigation practices yield economic benefits and reduce environmental burdens such as inefficient use of water and energy. Utilization of available water by reducing all forms of loss is the key to increasing crop yields, especially in dry areas.

Based on the conditions, this research was conducted with the purpose to find the best method of irrigation which is able to maintain soil moisture in order to increase soybean production.

METHOD

The research was conducted in The Maros district from June to October 2021, which took place at the experimental garden of the Soil Laboratory of the Agricultural Technology Assessment Agency, Maros district. The experiment used a randomized block design consisting of four treatments, namely: A0 = Sprinkling with water, A1 = Sprinkle method, A2 = Furrow method and A3 = Flood method. Each treatment was repeated three times so that there were 12 experimental plots in total.

RESEARCH METHODS

In the field, the distance between treatments was isolated with a minimum distance of 2 m to avoid water seepage from other treatment plots. In each plot, a sluice gate is installed with a water meter installed to calculate the amount of water entering. The amount of water given is the same for each treatment, where the soybean water requirement during its life cycle is 6.1 liters/plant, the number of plants in one bed is 75 so that the total water needed in one bed until production is = 458 liters and is given in stages, namely every 10 days (eight times of

administration) and each time the provision of water as much as 57 liters of beds. The plot size was 3 m x 2 m and the water channel was made according to the width of the plot (2 m) as well as the boundary of the treatment plot. The aqueduct is made 30 cm deep and 25 cm wide. The observation parameters were: plant height, number of leaves, root length, flowering age, dry weight of the plant, number of pods, weight of 100 seeds, weight of seeds planted and production per hectare.

RESULTS AND DISCUSSION

Results

The observation findings on the various parameters namely, plant height number of leaves, root length, and plant dry weight are presented in Table 1.

The observation findings on the various parameters namely, number of pods, weight of 100 seeds, weight of seed per plant, and production per hectare are presented in Table 2.

Discussion

Growth Parameters

The results showed a significant effect on plant height parameter, where the flood method gave the best results compared to the other methods, this was because the method was able to meet the water needs of each growth phase, especially the initial phase and the active vegetative growth phase, and the flowering phase. This is in line with Suryana's statement (2008) that wet cultivation of soybeans in the field can increase yields by about 70% compared to conventional irrigation. This is supported by the results of research (Prakash et al, 2018) which found that plants that experienced water stress during the flowering and vegetative growth stages had significantly lower yields and total dry matter. Additional irrigation significantly increases yields.

Table 1. Effect of irradiation on morphological characters of plant height, number of leaves, root length, plant dry weight, on M1 derivatives of three soybean varieties subjected to drought stress.

Treatment	Plant's Height	Number of Leaves	Root's Lenght	Plant's Dry Weightan
A0 (Control)	49,76 a	24,78 a	16,20 a	25,11 a
A1 (Sprinkle Method)	58,92 ab	27,67 ab	19,69 ab	27,67 ab
A2 (Furrow Method)	65,39 ab	30,56 ab	21,44 b	33,56 ab
A3 (Flood Method)	72,90 b	36,44 b	22,92 b	36,44 b
HSD 0,05	20,147	8.832	4,275	9,977

Description: Numbers followed by different letters in the same column, significantly different at the HSD 5%= Honestly significant difference

Table 2. Effect of irradiation on the number of pods, weight of 100 seeds, weight of seed per plant, and production per hectare on M1 derivatives of three soybean varieties subjected to drought stress.

Treatment	Number of Pods	Weight of 100 Seeds	Weight of Seed Per plant	Production of Seed Per Hectare
A0 (Control)	87,00 a	10,33 a	22,74 a	2,84 a
A1 (Sprinkle Method)	140,33 b	11,78 a	33,33 b	4,17 b
A2 (Furrow Method)	132,89 b	11,33 a	27,83 ab	3,48 ab
A3 (Flood Method)	154,89 b	12,89 b	34,58 b	4,32 b
HSD 0,05	35,091	1,663	8,259	1,039

Description: Numbers followed by different letters in the same column, significantly different at the HSD 5%= Honestly significant difference.

Likewise with the number of leaves parameter, where the flood method gives the best results compared to other methods. Leaves as a place for photosynthesis, where there is chlorophyll which is an element that determines the photosynthetic ability of plants. Chlorophyll is a pigment that has a function in the process of photosynthesis in plants. The higher the leaf chlorophyll content, the higher the ability to photosynthesize. Taiz and Ziger, 2002 said that in the process of photosynthesis, plant chlorophyll is a complex molecule that plays a role in capturing sunlight energy which is a process of energy and electron transfer. Praba (2008) found that a long enough drought in plants, especially in the vegetative phase, will cause negative effects that have an impact on inhibition of growth, development, osmotic pressure, and plant production.

The root length parameter also has a significant effect, it can be seen that the control and scatter method, which is a method that is considered to have less evenly distributed water, causes the use of water to be less effective and efficient so that the roots look longer than other treatments, this is stated by Salisbury et al., 1992, that plants that are stressed by lack of water will have the ability to carry out root interception, namely the ability of roots to extend themselves to areas farther from the root base to get water or other nutrient sources. The root system is able to increase resource absorption and penetrate dense soil (hardpan) which is important to increase soybean productivity in optimal and sub-optimal environments (Harrison et al, 2018).

Production Parameters

Water and soil are the two most important resources for food production. however, the sustainability of water resources and agricultural land is faced with challenges due to intensive human activities and climate change (Xiao Liu et al, 2018).

The results of Aminah et all research, (2013) found that soybeans given water stress of 150 mm/season (below normal requirements) showed a very significant difference with soybeans receiving 300 mm of water/season (normal requirements) namely, there was a very significant decrease. both to the components of plant growth (plant height, number of leaves, number of pods, and plant dry weight) as well as to production components (weight of 100 seeds, weight of plant seeds, and production per hectare).

In another study conducted by Aminah et al (2017) on the importance of water management using the crop system model, it was found that predicting water management and planting time depending on the water availability is very necessary considering our country as a country with a tropical climate with a bimodal rainfall pattern.

Treatment of the method of giving water to production factors, namely the number of pods, weight of seeds planted and production per hectare, all showed a significant effect, except the weight of 100 seeds. Where the inundation method showed higher yields than other watering methods, namely the number of pods was 154.89, the weight of the seeds was 12.89 grams and the production per hectare was 4.32 tons. This is because almost every phase of plant growth and development is available enough water so that production is higher.

This is in line with research by Aminah et al (2020) who found that continuous immersion with a water level of 5 cm increased soybean seed yield (seed weight) by 19.23% compared to field capacity. because this was supported by an increase in harvest components such as the number of pods and the number of seeds planted by 31.1% and 37.59% compared to field capacity, respectively.

The same thing was done by (Pedersen and Lauer, 2004), that the stress of lack of water that occurs especially during flowering, pod formation and seed filling will reduce yields by reducing the number of pods, seeds, and seed weight.

Although soybeans as secondary crops do not require much water, at the

initial stages of growth, flowering and pod filling, water availability is very necessary. When experiencing drought at that stage, soybean productivity can decrease 40-65% (Adisarwanto, T and R. Wudianto, 2007)

This is also in line with research by Muhumed (2014) which states that managing the availability of water, either in a way or in quantity, can increase soybean productivity.

Irrational use of agricultural water resources and low efficiency of irrigation water has become the biggest obstacles to sustainable agricultural development (Liu et al, 2017)

Therefore, increasing the efficiency of water use by finding the best method of water management in agriculture is a fundamental way to overcome the shortage of agricultural water resources. and it is very important to maximize the use of agricultural water resources and economic benefits for sustainable development. Zhang et al. (2014).

CONCLUSION AND SUGGESTION

Conclusion

The results showed that the provision of water with the puddle method gave the best effect on almost all parameters of growth and production observations where the highest yields were obtained for production per hectare, namely 4.32 tons, number of pods 154.89, seed weight 34.58 grams and weight 100 seeds 12, 89 grams.

Suggestion

It is advisable to use the flood method especially, when the water availability is much enough to provide for the plant's need.

In addition to theproduct obtained in the field, it is recommended to compare it with the potential results that may be obtained with this method.

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