

Implementation of the Jajar Legowo System to Increase Hybrid Maize Production Optimization in Dry Land

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Abstract

The plant spacing application on maize affects plant density, efficiency of light use, and plant competition in water and nutrients, ultimately affecting crop production. Each maize variety requires the appropriate spacing for optimal growth and maximum yield. This study aims to determine the growth and yield of hybrid maize at various spacings. This research was conducted in BlangGlong Village, Aceh, from May - October 2021. The materials used were hybrid maize varieties BISI 18, NASA 29, and JH 37. Tests in a factorial randomized block design with six treatment combinations and three replications. The treatment consisted of two factors spacing with two levels and varieties with 3 levels. The first factor is the spacing of the Jajar Legowo system (2:1) using a spacing consisting of 2 levels, namely 15 cm x (30 cm-80) and 30 cm x (30 cm-80). The second factor is maize varieties. Data were analyzed by ANOVA, if the F value was greater than the value in the F table, it was continued with Duncan's Multiple Range Test at a significance level of 95%. The results showed that the spacing of 30 cm x (30 cm-80) with BISI 18 variety had the highest yield of 11.42 tons ha⁻¹.

Keywords: *plant density, maize production, and dry land*

1. Introduction

Maize is a strategic food crop as food, feed, and industrial raw materials. The increasing domestic demand for maize, if not balanced with an adequate increase in production, will cause Indonesia to import large quantities of maize (Moelyohadi et al., 2012). In Indonesia, about 43% of maize is planted during the dry season (Kasryno et al., 2007). The increase in maize productivity continues to be carried out by applying the right cultivation technology for site specifics. One of the technologies applied to increase maize productivity is spacing (Jajar Legowo spacing) and the use of superior and quality seeds. (Betran et al. 2003).

In maize cultivation, the technology component of spacing between plants is needed to get maximum results. This technology is needed to obtain optimal population levels, ease of maintenance; get additional feed effect (in planting jajar legowo sisip); reduce competition for nutrients between plants, and maximize the reception of sunlight to plants so that the photosynthesis process can be maximized. One of the technological innovations for setting spacing is planting jajar legowo. The selection of superior varieties to be planted by farmers must consider aspects of soil and climate (environment), farmers' interests, high yield potential,

resistance to pests and diseases and drought, and early maturity. Superior varieties have a significant role in increasing productivity because they can provide high yields, are resistant to pests and diseases, and have a high potential for animal feed production (tebon) that can be used as animal feed.

Aceh Province is one of the provinces that has a fairly wide dry land, namely $\pm 556,885$ ha (BPS, 2020), which is mainly used for maize cultivation, namely $\pm 88,653$ ha with a production of 268,653 tons, most of which is planted in a suboptimal dry land with hilly types.

In contrast to rice, the application of the legowo system on maize is more directed at increasing the intensity of sunlight for optimizing photosynthesis and assimilation as well as facilitating plant maintenance, mainly weeding weeds either manually or with herbicides, fertilizing, and providing water.

The spacing arrangement is very influential on plant growth and yield. This affects the amount of sunlight received, the root system, and the number of nutrients absorbed from the soil so that it will affect the leaf area and dry weight of the plant. The use of proper spacing will increase yields, while the use of improper spacing will reduce yields (Indrayati, 2010).

Based on the importance of setting plant spacing for optimizing photosynthesis and assimilation in increasing the productivity of hybrid maize, this study aims to determine the growth and yield of hybrid maize at various spacings.

2. Materials and Methods

This research was conducted in Blang Glong Village, Bandar Baru District, Pidie Jaya Regency, Aceh, from May - October 2021. Soil analysis was carried out at the Soil and Plants Laboratory, Aceh Assessment Institute for Agricultural Technology (BPTP), Banda Aceh.

The materials used in this study were hybrid maize seeds of BISI 18, NASA 29, and JH 37 varieties, organic fertilizer, Urea, SP-36, and KCl. This research was conducted from Mei to October 2020 in Pidie Jaya Regency, Aceh, using a factorial randomized block design (RAK) consisting of 2 (two) treatment factors with three replications. In each treatment, 15 plants were assigned as samples. The first factor is the spacing of the Legowo Jajar System (2:1) which consists of 2 levels, namely 15 cm x (30 cm-80) and 30 cm x (30 cm-80). The second factor is maize varieties, namely BISI 18, NASA 29, and JH 37 varieties. Data were analyzed by ANOVA; if the value of F is greater than the value in table F, it is continued with Duncan's Multiple Range Test at a significance level of 95%.

The observed variables included the vegetative and generative growth phases. In the vegetative growth phase, the data observed were agronomic data consisting of plant height, number of cobs per plot, number of cobs harvested, the diameter of cobs, weight of cobs with cob, and the weight of peeled cobs, and harvest age. While in the generative phase, the yield components were observed, namely the weight of 1000 seeds, dry shelled weight, and yield.

Soil analysis was carried out using various analytical methods suitable for each nutrient, such as soil texture using the hydrometer method (Bouyoucos, 1962), pH with H₂O extract 1:5 (ISRIC. 1993), C-organic and total nitrogen with Wakley and Black (Black, 1965; Sudjadi et al. 1971), phosphorus with 25% HCl extract (Watanabe and Olsen, 1965) and Olsen (Steel and Torrie, 1960) and potassium with 25% HCl extract ((Black, 1965; Sudjadi et al. 1971)). The results of

the observations carried out the analysis of variance (ANOVA) at the 95% confidence level; if the p-value is greater than the p table, then it is continued with Duncan's Multiple Distance Test (DMRT) at a probability level of 5% (Sundari, et al., 2016).

3. Results and Discussion

3.1. Soil Condition of Research Site

The nutrient content in the soil at the research site is essential to determine the correct input of fertilization technology in terms of material dosage and fertilization time so that it cannot be available in the growth and production phase of hybrid maize. Fertilization was carried out with the same dose on all spacing treatments and hybrid maize varieties.

Table 1. Results of soil analysis before the study at the research location in Blang Glong Village, Pidie Jaya Regency, Aceh

No	Parameter Analysis	Results	Criteria
1	Texture		Sandy clay
	-Sand (%)	56.90	
	- Muddy (%)	22.58	
	-Clay (%)	20.53	
2	pH		Acid
	-H ₂ O	5.85	
3	Organic Matter		low Low Low
	-C-Organic (%)	1.49	
	-N total (%)	0.16	
	-C/N	9.23	
4	Extract HCl 25%		Low Low
	-P ₂ O ₅ (mg100g ⁻¹)	16.56	
	-K ₂ O (mg100 g ⁻¹)	19.28	

Note: analyzed at the Soil and Plant Laboratory of the Aceh Assessment Institute for Agricultural Technology (BPTP)

The soil analysis results showed that the nutrient content in the soil was in the category of sandy loam texture, low organic matter, and moderate NPK content, so fertilization was necessary to increase the availability of nutrients in the soil.

3.2. Plant growth and production/yield

Vegetative growth plays an important part in development in the generative phase. Optimal vegetative growth will encourage optimal generative growth so that high yields will be obtained. Based on the results of the ANOVA analysis of the observed variables (Table 2), it was shown that the spacing had a very significant effect on the diameter of the cobs, the weight of the cob, and the weight of the cobs without the cob, the dry shelled weight, and yield. The observation of the length of the cob has a very significant effect on each variety.

Table 2. The results of the analysis of variance ANOVA on various observation variables Legowo Jajar System Implementation to Improve Optimization of Hybrid Maize Production in Dry Land.

Variabel	Independent		Interaction
	Planting Distance	varieties	
Cob diameter	**	*	tn
Cob + husk	**	*	tn
Cob without husk	**	*	tn
1000 Grains	*	*	tn
Dry Shelled Seeds	**	*	tn
Result	**	*	tn

Information: tn = no significant effect, * = significant effect (0.05), ** = very significant effect (0.01).

3.3. Cob diameter (mm), the weight of cob with husk, and weight of cob without husk (grams)

The results of the analysis of variance showed that there was a very significant difference in the independent treatment of plant spacing on the diameter of the cob. However, it was significantly different in the varietal treatment. The largest cob diameter was found at a spacing of 30 cm x (30 cm-80), which was 4.25 mm, and in the BISI 18 variety, 4.18. The highest independent treatment of cob with husk weight and weight of cob without husk was found in the treatment with a spacing of 30 cm x (30 cm-80), which was 228.43 and 194.40 grams, while in the varietal treatment it was found in the Bisi 18 variety, which was 221.90 and 192.90, respectively.

Differences in spacing will affect the density of the canopy and affect the amount of light intensity that can be received by the plant canopy. However, the different sizes of the stem diameter as a response of plants to plant density are strongly influenced by genetics. (Akino et al., 2012).

Table 3. The results of Duncan's Multiple Range Test 95% analysis of the independent treatment of plant spacing and hybrid maize varieties on cob diameter (mm), cob with husk (grams), and cob weight without husk (grams)

Observation	Independent				
	Planting distance		Varieties		
	15 cm x (30 cm-80)	30 cm x (30 cm-80)	BISI 18	NASA 29	JH 37
Cob Diameter (mm)	3.98 b	4.25 a	4.18 a	4.06 a	3.95 b
cob with husk (grams)	208.77 b	228.43 a	221.90 a	215.30 a	207.73 b
cob without husk (grams)	184.17 b	194.40 a	192.90 a	185.67 a	182.80 b

Note: Numbers accompanied by different letters in each row and column show a very significant difference based on the Duncan's Multiple Range Test 95%

Planting distance is closely related to plant density which significantly influences the light intensity and the balance between CO₂ produced by respiration (Mayun et al., 2018). The appropriate plant density will affect the light intensity obtained by the plant, affecting the photosynthesis process in the formation of biomass and ultimately affecting production. Wide spacing will reduce competition for nutrients, light, and water so that the formation of cobs and filling of seeds on the cobs will be more optimal (Wahyudin et al., 2017).

3.3. Weight of 1000 grains (grams), dry shelled seeds (grams), and yield (t/ha)

The weight of 1000 grains and the weight of dry-shelled seeds were observed variables of yield components in maize that affected the yield (tons) of hybrid maize. In addition, the availability of nutrients in sufficient and balanced quantities will affect plant growth and production in the generative (production) phase (Satria, 2014). The results of the analysis of variance on the weight of 1000 seeds showed that there was a significant difference between spacing and varieties, where the highest number of 1000 seeds was found at a spacing of 30 cm x (30 cm-80), which was 26.47 grams, while the highest number of 1000 seeds was found in varieties. BISI 18 is 26.17 grams.

Table 3. The results of Duncan's Multiple Range Test analysis of 95% of the independent treatment of plant spacing and hybrid maize varieties on the weight of 1000 grains (grams), dry shelled seeds (grams), and yield (t/ha).

Observation	Independent				
	Planting distance		Varieties		
	15 cm x (30 cm-80)	30 cm x (30 cm-80)	BISI 18	NASA 29	JH 37
Weight 1000 seeds (grams)	25.00 b	26.47 a	26.17 a	25.30 a	24.25 b
Dry shelled weight (grams)	161.50 b	167.07 a	165.93 a	162.63 a	154.67 b
Yield (t/ha)	10.96 b	11.63 a	11.42 ab	11.17 a	10.65 b

Note: Numbers accompanied by different letters in each row and column show a very significant difference

Plant spacing and varieties significantly affected dry-shelled maize weight, where the highest yield was found at a spacing of 30 cm x (30 cm-80), i.e., 167.07 grams, while for varieties, the highest was found in the BISI 18 variety, which was 165.93 grams. The weight of dry-shelled seeds is related to the amount of photosynthate translocation into the seeds. Rahni (2012) stated that the increase in dry weight of seeds was related to the amount of photosynthate translocation into the seeds and the better the plant root system can absorb nutrients from the soil. Translocation of photosynthate, which is quite significant to the reproductive organs, causes cob formation and seed filling to take place well, and the seeds are formed with a larger size. The high dry seed weight indicates the optimal seed filling process. Ukonze et.al.,2016, stated that the high cob weight yield may be due to the number of seeds in each measured cob.

The analysis of variance showed that the treatment of plant spacing and 3 (three) hybrid maize varieties significantly affected the yield/production (tonnes). The highest yield was found in the treatment with a spacing of 30 cm x (30 cm-80), which was 11.63 t/ha, while the highest yield was found in the BISI 18 variety, which was 11.42 t/ha.

Taufik et al. (2004) mention that crop production is closely related to the availability of nutrients related to the seed filling process. Nutrients that are absorbed will be accumulated in the leaves into proteins that form seeds. The accumulation of metabolic products in the formation of seeds will increase so that the seeds formed have a maximum size and weight; this occurs when the nutrient needs are fulfilled, which causes the metabolism to run optimally. Related to the Agus Wahyudi et al. (2018) research states that "good growth is supported by adequate nutrient absorption, increasing the photosynthesis results, and stored in the storage network so that it affects the development and growth of plant parts, which in turn will increase the maize yield significantly.

4. Conclusion

The results showed that the spacing of 30 cm x (30 cm-80) and the BISI 18 variety significantly affected the growth and yield of hybrid maize. Bisi 18 variety has the highest yield/production of 11.42 t/ha.

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