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EFFECT OF DIFFERENCES IN PLANTING DISTANCE ON GROWTH AND YIELD OF *Zea mays* in RED-YELLOW PODZOLIC SOIL

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ABSTRACT

The problem that occurs in efforts to increase zea mays production is low land productivity, especially for red-yellow podzolic soil types. Setting plant spacing is an important factor to increase crop production easily and not increase production costs. Increasing the plant population per unit area can increase yields, but if the plant population continues to be increased, the yield will actually decrease. The aim of this research was to determine the response of growth and production of Zea mays to plant spacing treatments and to determine the correct planting distance with a high growth and production response. This research used a Randomized Block Design with 4 treatments, namely: P1 = planting distance 100 x 20 cm; P2 = planting distance 80 x 20 cm; P3 = planting distance 60 x 20 cm; and P4 = planting distance 40 x 20 cm; and repeated 3 times. Observation variables included plant height, ear weight, ear diameter, ear length, and sweetness level. The data analysis used was analysis of variance to determine whether the treatments were significantly different or not and continued with the LSD test with a significance level of 5%. The research results showed that differences in the planting distance of Zea mays on red-yellow podzolic soil had an effect on plant height, cob weight without corn husks, cob weight with corn husks, and cob length. Treatments P1 and P2 were the best treatments for the variables plant height, cob weight without corn husks, and cob weight with corn husks. Meanwhile, for the cob length variable, the best treatment is the P1 treatment.

Key words: Planting distance, Red-Yellow Podsolic, Production, Soil, Zea mays

INTRODUCTION

Corn (*Zea mays*) is corn from a group of horticultural crops that is popular with the public because it tastes sweet compared to other corn. The sugar content in sweet corn is higher compared to other types of corn. Corn consumption levels continue to increase along with the increase in population and consumption patterns of Indonesian society [1]. Increasing market demand and the high economic value of corn mean that sweet corn needs to be developed to increase production. In general, increasing corn production can be done through the use of superior and quality seeds, the use of fertilizers and cultivation techniques.

The problem that arises in efforts to increase corn production is low land productivity, especially for red-yellow podzolic soil types. According to [2], acid dry land in Lampung is mostly dominated by red-yellow podzolic soil. Podzolic is a type of soil with low productivity [3]. The chemical properties of red-yellow podzolic soil generally have the characteristics of a very acidic to slightly acidic soil pH, low to moderate levels of organic C percentage, low to moderate P levels, and low and very low concentrations of K, Ca, Mg, Na, and other base saturation levels [4].

Alternative to increasing corn production is cultivation techniques, one of which is by regulating plant spacing. Setting plant spacing is an important factor to increase crop production easily and not increase production costs. According to [5] one of the determinations of planting distance is soil fertility. Irregular planting distances will result in competition for sunlight, water and nutrients. Setting plant spacing aims to ensure that each plant in a population has sufficient space to obtain nutrients, sunlight, and makes maintenance easier [6]. Using appropriate plant

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spacing is very important in maximizing the use of sunlight for the photosynthesis process [7]. [8] said that regulating corn planting distances has a real effect on increasing production.

Using the right corn planting distance on red-yellow podzolic soil will result in high production. Increasing the plant population per unit area can increase yields, but if the plant population continues to be increased then plant growth will not be optimal and yields will actually decrease. Tight plant spacing results in the nutrient absorption process becoming less efficient, because the roots in the soil are interlocked so that competition between plants to obtain nutrients becomes greater. Meanwhile, the red-yellow podzolic soil type has low nutrient content and is a limiting factor in increasing production. Therefore, it is necessary to carry out this research in order to obtain the right planting distance so that it can provide high growth and production of corn plants on red-yellow podzolic soil.

MATERIALS AND METHODS

This research was carried out from March-May 2023, located at the Lampung State Polytechnic Plant Laboratory Land, Bandar Lampung City, Lampung Province. The tools used in this research included a sickle, hoe, hose, tape measure, plastic rope, tape measure, caliper, scales and refractometer. Meanwhile, the materials used include sweet corn seeds of the Bonanza F1 variety, manure, NPK pearl fertilizer, Furadan 3 g, and water. The method used in this research used the Randomized Group Design (RAK) method with 4 treatments, namely:

P1 = Plant spacing treatment 100 x 20 cm
P2 = Plant spacing treatment 80 x 20 cm
P3 = Plant spacing treatment 60 x 20 cm
P4 = Plant spacing treatment 40 x 20 cm

Each treatment was repeated 3 times to obtain 12 experimental units. Each experimental unit is a treatment plot measuring 3x3 m.

Implementation of Research

The land used measures 11x15 m. The land is first cleaned of weeds and processed twice. Next, treatment plots were made with a size of 3x3 m, with a distance of 1 m from one plot to another. Then basic fertilization is carried out using manure at a dose of 10 tons ha^{-1}. Planting is done by making a planting hole first using a drill with a depth of 3 cm. The planting distance used is in accordance with the treatment in each plot. Insert 1 seed into the planting hole. Then sprinkle with a little Furadan and cover again with soil. Fertilization uses Compound NPK fertilizer at a dose of 300 kg ha^{-1}. Fertilization was carried out 3 times when the plants were 7, 35 and 45 DAP. Fertilization is done by digging around the planting hole. Plant maintenance includes watering, replanting, weeding and mulching. Watering is done every day using a hose until the water is saturated. Embroidery is carried out on plants that do not grow after 7 days after planting. Weeding and hilling is done once every 2 weeks. Harvesting is done when the plants are 75-80 DAP.

Observation

The variables observed in this research were plant height, cob weight with corn husks, cob weight without corn husks, cob diameter, cob length, and sweetness level.

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Analysis Data

The observation data obtained was analyzed of variance at a significance level of 5% to determine whether the treatments were significantly different or not. If the assumptions are met, a further test is carried out using the Least Significant Difference (LSD) test at a real level of 5%

RESULTS AND DISCUSSION

Plant Height

Height observations were made until the plants were 56 DAP. This is because the vegetative period of corn plants ends at 56 DAP after planting. This is in line with the statement of [9] that corn plants enter the final vegetative period at the age of 56 DAP. Based on plant height observation data (Table 1), the results of the analysis of variance showed that plant height was not significantly different when observed when the plants were 14, 28 and 42 DAP. This is thought to be because the height of the plants produced is still low and do not cover each other, so the plants still have enough space to grow and get good sunlight. Apart from that, the availability of nutrients absorbed for the growth of corn plants is still available to the plants because fertilization is still carried out until 45 DAP after planting. According to [10] environmental factors that influence plant growth such as the availability of water, nutrients, humidity, temperature and sunlight, where these factors are needed in sufficient and appropriate quantities. The availability of sufficient nutrients during growth causes plant metabolic activity to be more active so that the process of cell elongation and differentiation will be better [11]. So in these observations the response of plant height between treatments was still the same and not significantly different.

Table 1. Average Plant Height *Zea mays*

Treatment	Plant Height (cm)			
	14 DAP	28 DAP	42 DAP	56 DAP
P1 = 100 cm x 20 cm	35.00	83.75	119.25	164.75 a
P2 = 80 cm x 20 cm	35.50	83.25	118.75	154.25 ab
P3 = 60 cm x 20 cm	34.75	83.00	116.75	146.25 b
P4 = 40 cm x 20 cm	34.75	81.25	106.50	126.00 c
LSD (5%)	tn	tn	tn	16.05

Note: Values followed by the same letter in the same column are not significantly different (LSD Test 0,05)

The response to the height of the new plants produced looked significantly different based on analysis of variance in observations when the plants were 56 DAP. The best results for observation plant height were treatments P1 and P2. In treatments P3 and P4 the resulting plant height response was not optimal. At this age, it is thought that the plants have started to close together and there is a reduction in the surface area of the leaves exposed to sunlight, so that the growth of corn plants in treatments P3 and P4 is lower than P1 and P2. Plant spacing that is too close will inhibit plant growth, but if it is too sparse it will reduce the population per unit area [12]. According to [13], the closer the plant spacing, the lower the leaf area index. As a result, the rate of photosynthesis also decreases. Meanwhile, at wider planting distances (P1 and P2), sweet corn plants can utilize the availability of root growth space as a place to obtain nutrients and the canopy as a place for leaves to grow for photosynthesis well. According to [14] the use of wide planting distances maximizes the absorption of nutrients and light, thus affecting the growth and production of corn plants.

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Weight Of Cobs With Corn husks And Without Corn husks

Analysis of variance showed that the plant spacing treatment applied gave significantly different results to the weight of cobs with corn husks and without corn husks. The best weight was obtained from treatments P1 and P2, both for the weight of cobs with corn husks and without corn husks. The average weight of cobs corn husks with and without corn husks is as follows (Table 2):

Table 2. Average weight of cobs with corn husks and without corn husks *Zea mays*

Treatment	Weight Of Cobs (g)	
	Cobs With Corn Husks	Cobs Without Corn Husks
P1 = 100 cm x 20 cm	437.50 a	341.75 a
P2 = 80 cm x 20 cm	427.25 ab	329.50 ab
P3 = 60 cm x 20 cm	374.00 b	282.50 b
P4 = 40 cm x 20 cm	260.50 c	190.75 c
LSD (5%)	61.42	48.14

Note: Values followed by the same letter in the same column are not significantly different (LSD Test 0,05)

The increase in cob weight in P1 and P2 is thought to be the result of increased plant growth in the vegetative phase. Based on measurements of plant height in the vegetative phase and measurements of cob weight in the generative phase, it shows that there is a positive correlation between the two (Figure 1). This is supported by the statement of [15] which states that good vegetative growth in corn plants can influence good generative growth results as well. Plant metabolic activity can encourage an increase in cob weight. The higher the weight of cobs produced by the plantation, the higher the production results [16]. Meanwhile, treatment P4 showed the lowest cob weight value expected due to the dense plant population in this treatment. The decrease in yield at close spacing is caused by the leaves in this population shading each other, thus affecting plant metabolic processes and resulting in reduced translocation of photosynthesis products to seeds. This is supported by the statement by [17] which states that plant population (planting distance) is one of the factors that can influence plant yields.

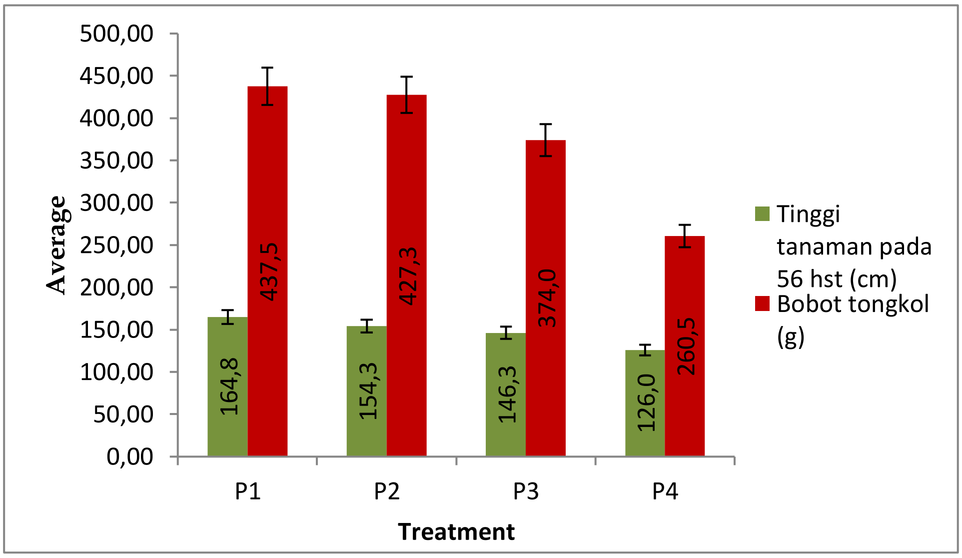

Figure 1. Comparison Graph of Plant Height And Cob Weight Between Treatments

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Cob Diameter And Cob Length

The effect of plant spacing treatment on cob diameter and cob length is shown in Table 3. The cob diameter values produced ranged from 4.39 – 5.10 cm. The highest cob diameter was obtained from treatment P1 and the lowest was obtained from treatment P4. However, based on the results of the analysis of variance at the 5% level of significance, it shows that between treatments the size of the cob diameter is not significantly different. According to [18] cob diameter is influenced by variety. So the treatment given does not affect the cob diameter.

Table 3. Average Corn Cob

Treatment	Cob Diameter (cm)	Cob Length (cm)
P1 = 100 cm x 20 cm	5.10	20.75 a
P2 = 80 cm x 20 cm	5.10	18.75 b
P3 = 60 cm x 20 cm	4.74	18.00 b
P4 = 40 cm x 20 cm	4.39	14.50 c
BNT (5%)	tn	1.07

Note: Values followed by the same letter in the same column are not significantly different (LSD Test 0,05)

For the cob length variable, the results of the analysis of variance showed that the treatment had a significant effect on cob length. The best average cob length was obtained from treatment P1. Based on observations, the increase in cob volume that occurs is thought to come from increasing cob length while the cob diameter tends to be the same or constant. This is supported by [19] statement that the availability of nutrients in sufficient and balanced quantities for plant growth causes the process of cell division, enlargement and elongation to take place better. In this case, P1 treatment with wide spacing provides sufficient nutrient availability for plants. This is in line with the opinion of [20] where the availability of nutrients, space and sunlight for plants is influenced by planting distance and will automatically have an impact on production. The wider the leaf area to capture sunlight and the higher the CO2 fixation, the greater the plant's photosynthesis will be and this will affect the assimilate yield as well [21].

Sweetness level

Based on sweetness level data (Table 5), the highest Brix degree value was $15{,}00^0$ obtained from treatments P1 and P2 while the lowest was $14{,}75^0$ obtained from treatments P3 and P4. The results of the analysis of variance showed that the plant spacing treatments did not differ significantly in the response to the sweetness level of the sweet corn produced.

Tabel 5. Average Sweetness Level

Treatment	Sweetness Level (^{0}Brix)
P1 = 100 cm x 20 cm	15.00
P2 = 80 cm x 20 cm	15.00
P3 = 60 cm x 20 cm	14.75
P4 = 40 cm x 20 cm	14.75
LSD (5%)	tn

According to the sweet corn description information, the Bonanza F1 variety has a sweetness level of between $13\text{-}14^0$ brix, while the observation results show that the brix value is maximum and above average compared to the variety description. According to [22] the level of sweetness of sweet corn is influenced by genetic factors so that the level of sweetness of the same type of plant will be the same. In this research, sweet corn from the same variety was used so it tends to produce the same level of sweetness. Meanwhile, the sweetness level value which is above the average

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description of sweet corn for the Bonanza F1 variety is thought to be caused by the corn harvest time which is carried out when the corn is 78 DAP. According to [22] the harvest time factor can also influence sugar synthesis in corn plants. [23] said that a long harvest time results in more carbohydrates being produced during the photosynthesis process so that the sugar content accumulated in corn seeds is higher.

CONCLUSION

Based on the results of research that has been carried out, it can be concluded that differences in sweet corn planting distances on podsolic land affect plant height, cob weight without husks, cob weight with husks, and cob length. Treatments P1 and P2 were the best treatments for the variables of plant height, cob weight without husks, and cob weight with husks, while for the cob length variable, the best treatment was the P1 treatment.

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