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Determination of The Critical Period of Sweet Corn Plants (Zea Mays Saccharata Sturt) Against Weed

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Abstract

The critical period is a time when cultivated plants are very sensitive to the presence of weeds so that the disturbance caused by them can reduce the final yield. So, no the entire growing period of plants is affected by weeds. This critical period relates to the time of proper control so that the presence of weeds does not always require control measures. This research aims to determine the critical period for sweet corn (Zea Mays Saccharata Surt) against weeds and the effect of weeds on the growth and yield of sweet corn plants. This research was carried out at Gampong Mesjid, Kaway XVI, West Aceh Regency, Soil Science Laboratory and Pest and Disease Laboratory, Agroecotechnology Study Program, Faculty of Agriculture, Malikussaleh University, North Aceh from February to April 2024. This research used an experimental method of randomized block design (RAK), the single factor that consists of 10 treatments with 3 repetitions. P1: 0-15 DAP with weeds, P2: 0-30 DAP with weeds, P3: 0-45 DAP with weeds, P4: 0-60 DAP with weeds, P5: 0-Weedy harvest, P6: 0-15 DAP weeds free, P7: 0-30 DAP weeds free, P8: 0-45 DAP weeds free, P9: 0-60 DAP weeds free, P10: 0-DAP harvest free from weeds. The observation data were analyzed using analysis of variance, the treatment average was obtained through Duncan's Multiple Range Test (DRMT) a the 0.05 level. The research results show that the critical period for sweet corn (Zea mays saccharata Sturt) for weeds is determined at the age of 16-30 days after planting. Weed control carried out between 16-30 days of plant age will not inhibit the growth and yield of sweet corn plants.

Keywords: *Weeds, Sweet Corn, Critical Period.*

1. Introduction

Sweet corn (Zea Mays Saccharata Surt) is one type of corn in Indonesia, which is a horticultural commodity and is worthy of being a leading commodity in Agribusiness. The prospects for developing sweet corn farming are very bright in order to increase farmers' income and welfare. Consumption of sweet corn is currently increasing along with population growth and changes in consumption patterns. Along with the increasing demand for sweet corn, it is necessary to be accompanied by efforts to meet the needs of sweet corn. The increase in national corn production reached 56.24% in a span of 4 years, namely in 2013 to 2017. Sweet corn production in Indonesia in 2014-2018 showed an increasing trend from 19.0 million tons to 30 million tons. The increase in production is also in line with the increase in the area of corn planting in Indonesia in 2013 to 2018 [1] [2].

Consumer demand for sweet corn continues to increase, where sweet corn production from year to year from 2014 to 2018 has always increased, in 2014 it was 19 million tons, in 2015 it was 19.61 million tons, in 2016 it was 23.57 million tons, in 2017 it was 28.92 million tons and in 2018 it was 30.05 million tons. Considering the economic value of sweet corn is quite high, efforts need to be made to increase sweet corn production [3]. Therefore, to maintain the production value from decreasing, there are several factors that need to be considered, one of which is weed control. The presence of weeds is a problem that continues to hinder sweet corn cultivation. The presence of weeds can significantly suppress growth and production because they become competitors in competing for nutrients and sunlight.

According to [4], Weeds are all types of plants other than cultivated plants. In the world of agriculture, weeds are plants that have a negative impact on cultivated plants directly or indirectly. Weeds are an important problem because they interfere with the main plants so that they can reduce crop production. The percentage of crop production decline in the type and density of weeds. The presence of weeds

in sweet corn plantations can reduce seed production and quality. The competition between sweet corn plants and weeds causes sweet corn production to decline by 13-51%.

Weed control is an effort to limit or suppress weed infestation to a certain level so that the cultivation of cultivated plants becomes productive and efficient. Weed control can be done mechanically, technical culture, biologically (biologically), chemically (use of herbicides), and integrated (integrated). Prevention and control measures are complementary. Mechanical weed control is an action to control weeds using simple tools to heavy mechanical tools to physically damage or suppress weed growth [5]

Weeding is a very practical, safe, efficient and especially cheap control method if applied to an area that is not too large and in areas with sufficient manpower. Choosing the right weeding time will reduce the number of weeds that grow and can shorten the competition period. In the life cycle of plants, not all growth phases of a cultivated plant are sensitive to competition from weeds [6].

The critical period is the period when cultivated plants and weeds are in a state of active competition with each other. The critical period of plants against competition with weeds is one of the important steps in preparing a plan for when the right control is carried out so as not to cause yield losses. The critical period or vulnerable period against competition with weeds is a consideration in determining when is the right time to control weeds and the right actions to be taken to control weeds.

Information on Determining the Critical Period of Sweet Corn (Zea mays saccharata Sturt) Plants Against Weeds is still very limited so that information from research results can later be used as recommendations for farmers in cultivating sweet corn regarding weed control during the critical period or as a source of information for agricultural programs on integrated weed control and management of sweet corn.

2. Research Method

This research was conducted in the abandoned land of Gampong Mesjid, Kaway XVI District, West Aceh Regency and the soil science and pest and disease laboratory of the Faculty of Agriculture, Universitas Malikussaleh in February-April 2024.

The equipment and materials used were hand tractor, handsprayer, hoe, machete, watering can, stationery, camera, scales, rake, nylon rope, meter, oven, caliper, brix refactometer, weed identification book, Bonanza F1 sweet corn seeds with red arrow brand, Mutiara NPK, urea fertilizer, TSP, KCL, organic fertilizer, insecticides and fungicides

The research was conducted using a single factor Randomized Block Design (RAK) namely weeded and weed-free treatments. P1: 0-15 HST weeded, P2: 0-30 HST weeded, P3: 0-45 HST weeded, P4: 0-60 HST weeded, P5: 0-Harvest weeded, P6: 0-15 HST weed-free, P7: 0-30 HST weed-free, P8: 0-45 HST weed-free, P9: 0-60 HST weed-free, P10: 0-Harvest HST weed-free. The number of treatments was 10 units with 3 replications so that there were 30 experimental units. Each experimental unit was 300 x 300cm, with a planting distance of 75 x 25 cm so that the total number of plants was 1,440. The sample area observed was 150 x 100 cm with the number of sample plants observed being 8 plants per plot. The measured land or area is then cleared of weeds that interfere with the plant area. Land clearing is done manually, namely by using tools such as machetes, hoes and other tools that help. Soil processing is done to obtain a loose soil structure so that plant growth and production can be optimal. The next step is to loosen the soil with a hand tractor and hoe, the soil that has been processed is then formed into a plot.

Planting is done by planting seeds directly into the plot, by digging holes to a depth of 3-4 cm with each hole containing 1 corn seed then covered again with soil.

Application of 1,500 kg/ha of manure by spreading it a week before planting. Urea fertilizer 250 kg/ha, TSP fertilizer 150 kg/ha and KCL 100 kg/ha. done by digging with a distance of 5 cm from the planting hole then covered with soil to prevent evaporation or erosion due to rainwater. Urea and KCL fertilization is done when planting and 30 HST, while TSP fertilization is given entirely when planting.

Maintenance carried out includes Watering is done twice a day, namely in the morning and evening, but if it rains, watering is not carried out. Replanting of seedlings that do not grow or there are plants that grow poorly is carried out at the age of 7 HST by moving reserve plants that have been prepared outside the research plot. Pest and disease control is carried out by monitoring pests and diseases and using pesticides and insecticides if necessary. In the observation of sweet corn plants, measurements were made of plant height, stem diameter, leaf area, flowering age 50%, weight of cobs with and without cobs, degree of fruit sweetness, dry biomass weight of plants. Weed components were determined by observing the weed population, NJD (Dominance Number Ratio), weed weight per species, dominant weed stalk weight and total weed biomass weight. Sweet corn can be harvested after the plants are 67 days old after planting.

3. Result And Discussions

The results of the analysis of variance showed that the height of weeded and weed-free plants did not have a significant effect on plant height. The average height of plants aged 10 HST was not significantly different in all treatments. The highest sweet corn plant height at 10 HST was P10 0- weed-free harvest 18,330 cm and the lowest P8 0-45 HST weed-free was 15.883 cm. In the measurement of plant height at 20 HST the highest plant was 38.227 cm P5 0-weeded harvest was significantly different from P7 0-30 HST weed-free, which was 25.880 cm. In the observation of plant age 30 HST the highest plant was 75.267 cm P10 0-weed-free harvest was significantly different from the lowest plant, which was 55.797 cm P7 0-30 HST weed-free. Observation of plants aged 40 HST the highest plant was 140.327 P10 0-harvest weed-free significantly different from P7 0-30 HST weed-free which was 115.867 cm but not significantly different from other weeded and non-weeded treatments (Table 1). The height of P4 0-60 HST weeded plants was 128.863 cm, not significantly different from P1 0-15 HST weeded which was 128.480 cm, also not significantly different from P6 0-15 HST weed-free of 127.340 cm. The height of P5 0-harvest weeded plants was 124.607 cm, not significantly different from P8 0-45 HST weed-free which was 123.767 cm. The height of sweet corn plants P9 0-60 HST free of weeds, namely 118.403 cm, is not significantly different from P3 0-45 HST with weeds, namely 118.207 cm and is not significantly different from P117.053 cm.

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Table 1. Sweet corn plant height

Treatment	Plant Height (cm)			
	10 HST	20 HST	30 HST	40 HST
P1	16,827 a	34,857 ab	65,593 ab	128,480 ab
P2	17,540 a	34,083 ab	62,833 ab	117,053 ab
P3	18,050 a	34,460 ab	59,993 ab	118,207 ab
P4	17,110 a	35,170 ab	65,643 ab	128,863 ab
P5	17,523 a	38,227 a	64,453 ab	124,607 ab
P6	17,563 a	34,323 ab	67,993 ab	127,340 ab
P7	16,040 a	25,880 b	55,797 b	115,867 b
P8	15,883 a	32,490 ab	60,927 ab	123,767 ab
P9	16,930 a	28,353 ab	58,603 ab	118,403 ab

Note: Numbers followed by the same letter in the same column are not significantly different at the 5% UJBD level.
Research conducted by Pratama and Agus [7], stated that observations of the height of sweet corn plants at seven days after planting until the sweet corn plants complete the vegetative phase show that weeds do not inhibit the growth of sweet corn plants. Plant height is influenced by hereditary factors, while the abiotic factor that influences plant height parameters is light. In accordance with the opinion of Lakitan [8], which states that light intensity is an important component for plant growth, because it will affect the photosynthesis process which affects plant height growth, so that plants that get a lot of light appear taller than plants that lack light. Wirahadikusumah [9], solar energy captured by the photosynthesis process is more than 90% of the energy source used by humans, for heating, light, and power. According to Sembodo [10], competition between weeds and plants occurs in the struggle for growth factors such as growing space, light, water, nutrients, CO2 and other materials. Competition between plants and weeds can occur if the plant growth factors needed are below the needs.

The results of the analysis of variance showed that the weeded and weed-free treatments had very different effects on the weight of the husked cob. The highest weight of the sweet corn husked cob in the weeded treatment was P1, which was 291.6 g and the lowest was P5, which was 187.1 g, very significantly different from P4, which was 210.9 g, very significantly different from P3, which was 247.9 g, and very significantly different from P2, which was 271.5 g. In the weed-free treatment, the highest weight of the sweet corn husked cob was P10 398.3 g and the lowest was P6, which was 291.9 g, very significantly different from P9, which was 370.1 g, very significantly different from P8, which was 358.6 g, and very significantly different from P7, which was 327.6 g. The weight of the sweet corn husked cob depends on several factors such as variety and harvest age. Different varieties of sweet corn have different cob sizes and weights. In this study, the harvest age was 67 days, the older the harvest age, the heavier the sweet corn cobs were.

Table 2. Weight of husked sweet corn cobs.

Treatment	Weight of corn cob with husk (g)
P1	291,6 f
P2	271,5 g
P3	247,9 h
P4	210,9 i
P5	187,1 j
P6	291,8 e
P7	327,6 d
P8	358,6 c
P9	370,1 b
P10	398,3 a

Description: Numbers followed by the same letter in the same column are not significantly different at the 5% UJBD level.
The results of research conducted by Hutasoit, et al. [11], showed that the results with normal conditions on the weight of sweet corn cobs ranged from 272.34 g to 436.32 g with an average of 346.05 g. In organic research, the weight of sweet corn cobs produced was lighter, around 222.97 g compared to conventionally, which was 285.00 g [12].
The results of the analysis of variance showed that weeded and weed-free treatments had a very different effect on the dry weight of sweet corn plants. The highest dry weight of sweet corn plants in the weeded treatment was P1, which was 164.1 g and the lowest was P5, which was 88.3 g, very significantly different from P4, which was 98.1 g, very significantly different from P3, which was 116.1 g, very significantly different from P2, which was 134.1 g. In the weed-free treatment, the highest dry weight of sweet corn plants was P10,

which was 214.8 g and the lowest was P6, which was 168.7 g, very significantly different from P9, which was 212.4 g, very significantly different from P8, which was 206.9 g, very significantly different from P7, which was 192.3 g.

Table 3. Dry weight of plants.

Treatment	Plant dry weight (g)
P1	164,1 f
P2	134,1 g
P3	116,1 h
P4	98,1 i
P5	88.3 j
P6	168,7 e
P7	192,3 d
P8	206,9 c
P9	212,4 b
P10	214,8 a

Note: Numbers followed by the same letter in the same column are not significantly different at the 5% UJBD level.

Plant dry weight is a reflection of photosynthate translocation to all parts of the plant, so that the plant growth rate is determined by the maximum photosynthesis rate. Plant growth rate can also be influenced by temperature and humidity. Prawiranata, et al. [13] stated that plant dry weight reflects plant nutrition because the dry weight depends on photosynthesis. The growth and formation of plant vegetative organs affect dry weight. This process is greatly influenced by the availability of nutrients for plants and the rate of photosynthesis. The more sunlight energy is converted in the process of photosynthesis into photosynthate, the greater the total dry weight of the plant.
Total weed weight is the dry weight of a mixture of all weed species found in each treatment. The results of the analysis of variance showed that the weedy and weed-free treatments had a very significant effect on the total weed weight. The highest total weed weight in the weeded treatment was P5, which was 948.2 g and the lowest was P1, which was 28.1 g, very significantly different from P4, which was 501.9 g, very significantly different from P3, which was 432.4 g, very significantly different from P2, which was 169.1 g. In the weed-free treatment, the highest total weed biomass was P6, which was 57.3 g and the lowest was P10, which was 0 g, very significantly different from P9, which was 13.7 g, very significantly different from P8, which was 27.5 g, very significantly different from P7, which was 52.9 g.

Table 4. Total weed weight

Treatment	Plant dry weight (g)
P1	164,1 f
P2	134,1 g
P3	116,1 h
P4	98,1 i
P5	88.3 j
P6	168,7 e
P7	192,3 d
P8	206,9 c
P9	212,4 b
P10	214,8 a

Note: Numbers followed by the same letter in the same column are not significantly different at the 5% UJBD level.
The longer the weed-free period, the total weed weight decreased (Table 4.) On the other hand, the total weed weight increased with the length of weeding period. The largest total weed weight was in the weed-until-harvest treatment and this is because weeds that are allowed to grow for a longer period will have the potential to develop and compete to enlarge their habitus so that their total weight will increase. The results of Pratama and Agus's [7] study showed that weeds that are allowed to be in the sweet corn planting area for a longer period of time will affect the weight of the weed piles which will be greater. This can happen because the growth facilities on the land are used more and more.

Weeds do not always have a negative effect on cultivated plants. Moenandir [14], stated that there is a period when weeds must be controlled and there is a period when weeds are also allowed to grow because they do not interfere with the plants. The period of plant life that is very sensitive to weed competition is called the critical period. According to De Wit [15], the critical period of plants is the phase of plant growth where the influence of environmental factors is greatest on crop yields. The critical period of plants is the phase of plant growth where the need for environmental factors is highest and even a slight deficiency or excess can significantly affect crop yields. If the critical period of competition at the beginning of growth can be controlled, the critical period at the next growth stage will not occur so that the crop yields obtained are optimal [16].

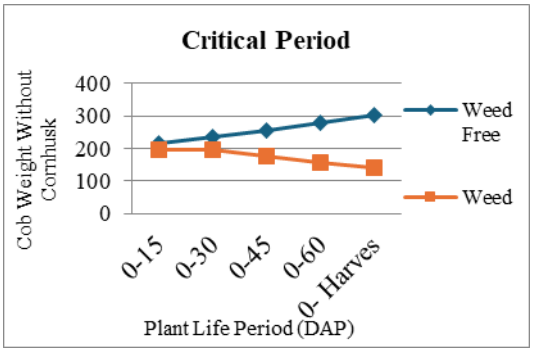

Fig 1. Critical period graph based on corn cob weight

The growth of sweet corn plants is generally influenced by weed competition as indicated by sweet corn yield components such as corn cob weight, total weed weight and dry plant weight. The weeded and weed-free periods show that the longer the weed-free period, the higher the sweet corn yield value and the weeded period shows the opposite result. In the weed-free period, the corn cob weight of sweet corn plants in the P7 0-30 HST treatment, which was 327.6 g, increased to 358 g (P8).

In the weedy period, the weight of sweet corn cobs began to decrease drastically in the P3 treatment, which was 247.9 g from 271.5 g (P2).

Figure 1 illustrates that if weeds in sweet corn plants are controlled at the age of 16-30 HST, it will increase the weight of sweet corn cobs. Conversely, if weeds in sweet corn plants are not controlled at the age of 16-30 HST, it will decrease the weight of sweet corn cobs.

The results of research by Padang, et al. [17], stated that the critical period for corn is at the age of 21 days to 28 days after planting. Meanwhile, Ngawit and Fauzi [18], stated that the critical period for sweet corn competing with weeds in the Lombok Tengah entisol is in the range of 30-40 days after planting. Weedy plants for 40, 50, and 60 days experienced a decrease in yield of 60.32%, 82.84% and 98.66%.

The weedy and weed-free periods of sweet corn plants also affect the dry weight of the plant. Figure 2 shows that if weeds are not controlled at the age of 16-30 HST, the dry weight of the plant will decrease during the weedy period. In the weed-free period, the opposite occurs, namely if weeds are controlled at the age of 16-30 HST, it will increase the dry weight of the plant.

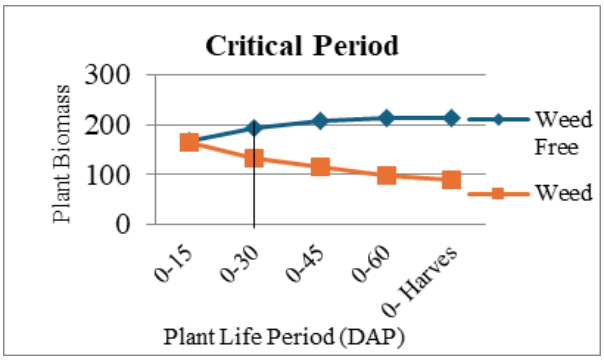

Fig 2. Critical period graph based on plant dry weight

According to research by Pratama and Agus [7], it states that the results of the critical period with an interval of 0-35 HST weeded and weed-free affect the weight of the sweet corn plant stalks. The presence of weeds until the age of the plant is 30-40 HST is a critical period for plants competing with weeds and the presence of weeds must be eliminated, so that there is no decrease in sweet corn yields. Allowing weeds to grow in the plant area during this age period and only weeding when the plant is 40 days old, causes the growth of the sweet corn plant to not be able to return to the normal phase and the plant yield cannot be maintained [18].

Competition between sweet corn plants and weeds not only affects the growth and yield of the plant but also affects the total weed weight. Figure 3 shows that the longer the sweet corn plants are weeded, the higher the total weed weight, and the longer the weed-free period, the lower the total weed weight. This is because the longer the weeding period, the older the weeds and the weed stems become mature and cause the water content to decrease.

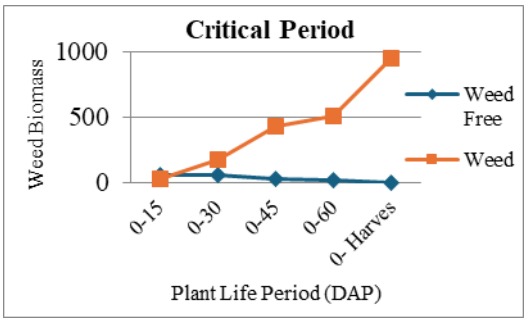

Fig 3. Critical period graph based on total weed weight

The results of the regression analysis showed the determination of the critical period in sweet corn plants (Zea mays saccharata Sturt) against weeds at the age of 16-30 HST. Weed control carried out between the ages of 16-30 days will not inhibit the growth and yield of sweet corn plants [19], stating that plants can grow optimally if weeds are controlled at the beginning of their growth, so that they can increase their competitiveness in competing with weeds. It was also stated that competition between weeds and plants is influenced by the time and length of the age period of plants competing with weeds. Moenandir [6], stated that the critical period of corn plants is between the ages of 20-30 days. According to Zimdahl [20], the critical period of plants occurs in the first 25% to 33% of the plant life cycle.

4. Conclusion

Determination of the critical period of sweet corn plants (Zea mays saccharata Strurt) against weeds at the age of 16-30 HST. Weeding is carried out during the critical period of sweet corn plants so as not to affect growth and yield.

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