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Time of detasseling and defoliation effect on hybrid sweet corn (*Zea mays saccharata*. Sturt) seed production

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ABSTRACT

Introduction: Sweet corn (*Zea mays saccharata Sturt*) is one of the horticultural crops that is in great demand in Indonesia because of its distinctive sweet taste and relatively short production time. To improve the quality and quantity of hybrid sweet corn seed production, it is necessary to apply appropriate agronomic techniques, such as detasseling (removal of male flowers) and defoliation (pruning leaves). This study aims to determine the interaction between detasseling time and the number of leaves pruned on the production parameters of hybrid sweet corn. **Methods**: The study was conducted in Wringintelu Village, Puger, Jember, from August to December 2022, using a factorial randomized block design (RBD) with three replications. The treatments consisted of three detasseling times (48 DAP, 50 DAP, and 52 DAP) and three levels of defoliation (no defoliation, 2 leaves, and 4 leaves). Data were analyzed using ANOVA and continued with a 5% DMRT test if there was a significant effect. **Results**: The results showed that the interaction of detasseling time of 48 DAP with 4-leaf defoliation gave the best results on the parameters of cob weight (78.55 g) and cob length (14.97 cm). Individually, the treatment of detasseling time of 48 DAP produced the highest seed production per hectare of 18.44 tons, while 4-leaf defoliation produced a production of 18.17 tons per hectare. **Conclusion**: In conclusion, the combination of detasseling time of 48 DAP and 4-leaf defoliation is the best treatment to increase the production of hybrid sweet corn seeds, so it can be a recommendation for agronomic practices to increase sweet corn productivity in Indonesia.

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INTRODUCTION

Sweet corn (*Zea mays saccharata Sturt*) is one of the most popular horticultural crops in Indonesia. In addition to having a distinctive sweet taste, this corn also has a relatively short production period compared to ordinary corn, so it is in great demand by the public. Along with increasing food needs and population growth, the demand for sweet corn continues to increase. This is reflected in data from the Indonesian Ministry of Agriculture, which recorded an increase in national sweet corn production from 28.92 million tons in 2017 to 30.05 million tons in 2018 (Indonesian Ministry of Agriculture, 2018). However, to meet this demand, the existence of high-quality hybrid seeds is very important. Optimal sweet corn seed production depends not only on breeding superior varieties, but also on the application of appropriate cultivation techniques, such as timing of detasseling and the number of leaves pruned (defoliation). These two techniques play an important role in ensuring the quality and quantity of yields, so a more in-depth study is needed to determine the most effective combination (Husna, 2021; Shodikin & Wardiyati, 2017; Sobarudin *et al.*, 2015).

In an effort to improve the quality and quantity of sweet corn seed production, the application of detasseling and defoliation techniques plays an important role. Detasseling, which is the removal of male flowers (tassels) before the emergence of female flowers (silks), aims to prevent self-pollination and ensure the genetic purity of hybrid seeds. This process also diverts the distribution of plant energy from vegetative growth to the formation of cobs and seeds, thus affecting overall yields. The right time for detasseling is very important, because if it is done too late, self-

pollination can occur which reduces seed quality (Shodikin & Wardiyati, 2017; Sobarudin *et al.*, 2015). In addition, defoliation, which is pruning the leaves below the cob, aims to increase the translocation of photosynthesis results to corn seeds. The number of leaves pruned has a significant effect on photosynthate accumulation, where proper pruning can reduce internal competition between plant organs, thereby increasing yields (Husna, 2021; Yulianto, Saleh, & Dukat, 2019). The optimal combination of detasseling time and the number of leaves pruned is an important focus in agronomic practices to support the production of quality hybrid sweet corn seeds.

Although detasseling and defoliation are known as important techniques in hybrid sweet corn cultivation, their implementation still faces various challenges. One of the main problems is the lack of specific studies on the combination of detasseling time and the number of leaves pruned to achieve optimal production results. Variability in environmental conditions, such as weather, soil type, and nutrient availability, also affect the effectiveness of these two techniques, making it difficult to establish universal guidelines (Azrai *et al.*, 2018; Yulianto, Saleh, & Dukat, 2019). In addition, delays or errors in the implementation of detasseling can cause self-pollination, which reduces the genetic purity and quality of hybrid seeds (Shodikin & Wardiyati, 2017). On the other hand, improper leaf pruning, both in terms of quantity and location, can reduce the photosynthetic ability of plants, so that production results are less than optimal (Suchocka *et al.*, 2021). Therefore, further research is needed to overcome this problem and produce applicable recommendations for farmers.

The purpose of this study was to analyze the interaction between detasseling time and the number of leaves pruned (defoliation) on the production parameters of hybrid sweet corn. The results of this study are expected to contribute to the development of better agronomic practices, especially in the application of optimal detasseling and defoliation techniques.

METHODS

Tools and materials

The tools and materials used in this study were a paddle, koret, sprayer, meter, push term, hoe, sickle, bucket, digital scale, diesel, digital scale, sweet corn seed grade of main seed, fungicide, insecticide, NPK Phonska fertilizer 300 kg/ha, SP-36 fertilizer 100 kg/ha, Urea fertilizer 350 kg/ha, KCl fertilizer 100 kg/ha.

Place of Implementation

The research was conducted in Wringintelu Village, Puger, Jember Regency from August to December 2022.

Research methods

The research began with the preparation of the tools and materials, then the soil was processed twice to make the soil texture loose and flat. The seeds used consisted of 1080 seeds of female elders and 270 seeds of male elders with a ratio of 1:4. Planting was done with a spacing of 75 x 20 cm. Two corn seeds were planted in each planting hole and then covered with compost. Each bed contained 20 planting holes. The planting split (difference in planting time) used was 2:0, with the female elders planted 2 days before the male elders. After that, basic fertilization was carried out with SP-36, Phonska, and urea fertilizers at the following rates. tugal system. Plant thinning was carried out by uprooting plants in each planting hole that grew more than 1. Thinning was carried out at the age of 14 DAP. The hilling process was carried out at the age of 15 DAP and 30 DAP by covering the rootstock of corn plants with soil using a hoe. The irrigation was carried out regularly while maintaining the condition of the plants. Weeding is carried out at the age of 14 DAP and 40 DAP so that the plants are protected from weeds. Roguing is carried out at 30-60 DAP if there are sympathetic-type plants, the goal is to maintain the quality of the seeds. Fertilization was carried out using phonska, KCl, and urea fertilizers. Supplementary fertilization 1 at 15 DAP with a dose ratio of 2:1:2, supplementary fertilization 2 at 30 DAP with a dose ratio of 1:2:2, and supplementary fertilization 3 at 45 DAP with a dose ratio of 1:2:2. Pest and disease control is carried out conditionally and preventively using pesticides. The treatment of detasseling time (removal of male flowers on female plants) was carried out according to the treatment level, namely at 48 DAP, 50 DAP, and 52 DAP. Leaf defoliation treatment was carried out at the age of 68 DAP according to the treatment level. After that, cutting the male elders aimed at maintaining genetic purity so that they would not be harvested. Then the harvest was carried out when it had entered physiological maturity at the age of 95-100 DAP. Harvesting was carried out by taking and separating the corn from the clobber. Next, the corn was shelled and air-dried until the moisture content reached ± 11%. The seeds were then sorted to obtain good-quality seeds. The observation parameters were cob diameter (mm), cob weight (gr), cob length (cm), number of seeds per cob (grains), and seed production per hectare (tons/ha).

Research design

The research design used was a factorial Randomized Block Design (RBD) and repeated 3 times. Detasseling time treatment consisted of 48 DAP (W1), 50 DAP (W2), and 52 DAP (W3). Leaf defoliation treatment consists of no defoliation (DO), 2 leaves (D1), and 4 leaves (D2). From the two factors, 9 treatment combinations were obtained so that 27 treatment units were obtained.

Data analysis

Data from the study were analyzed using ANOVA, if it shows a significantly different effect, it will be continued using the 5% DMRT test.

RESULT AND DISCUSSION

The results show that there was an interaction between detasseling and defoliation time on cob weight and cob length (Table 1), while the treatment of detasseling and defoliation time each gave a very real and real effect on the number of seeds per cob and seed production per hectare (Table 2) and (Table 3), but on cob diameter gave no real effect (Figure 1).

Table 1. Cob weight and cob length due to the interaction of detasseling and defoliation time treatments Detasseling and Defoliation Time

Detasseling and Defoliation Time	Cob Length (cm)	Cob Weight (gr)
48 DAP dan No Defoliation	13,66 a	60,91 ab
48 DAP dan 2 Leaves	13,97 ab	64,87bc
48 DAP dan 4 Leaves	14,97 c	78,55 d
50 DAP dan No Defoliation	14,64 bc	64,44 abc
50 DAP dan 2 Leaves	13,90 ab	62,32 abc
50 DAP dan 4 Leaves	14,92 c	68,65 c
52 DAP dan No Defoliation	13,62 a	57,16 a
52 DAP dan 2 Leaves	14,39 abc	62,37 abc
52 DAP dan 4 Leaves	14,43 abc	60,33 ab

Notes: Numbers followed by the same notation in the same column show no significant difference in the 5% DMRT test

The treatment with the fastest defoliation time and the most leaf defoliation gave the most optimal results compared to other treatments. Based on Table 1, the defoliation time of 48 DAP (days after planting) and 4 leaf defoliation produced a cob length of 14.97 cm and a cob weight of 78.55 g. According to Subardja (2017), during the period from cob formation to corn kernel filling, the nutritional needs of corn are quite high, so that the assimilation produced through photosynthesis is transferred more to the cob. This is in accordance with the conditions at the age of 48 DAP, when corn has entered the generative phase, which focuses on cob formation and seed filling. Corn cobs are a modification of the branches of the corn plant, where the cob stem is a modification of the stem, while the cob itself is a modification of the leaves, and the corn kernels develop from the flowers. In addition, the results of pruning male flowers—by removing the top of the plant—can affect the direction of growth, because phytohormones will direct growth to the branches of the plant (Nadeem, 2016). In this context, Satriyo *et al.* (2016) stated that leaf defoliation treatment can lengthen and widen corn cobs. This is related to the increased ability of plants to produce assimilate through leaves, which is then distributed to other plant organs, especially corn cobs, which are parts of the plant that have high economic value. This increase in photosynthetic activity can affect the length of the cob, because the more food reserves are produced, the longer and wider the cob will be. Le Roncé (2020) also emphasized that the distribution of assimilate between vegetative and generative organs is greatly influenced by the interaction between pruning male flowers and leaf defoliation. Husna (2021) added that increased photosynthetic activity can increase the amount of photosynthate produced and then transferred to the cob as a food reserve, so that the diameter and length of the cob increase along with the amount of food reserves formed. With 4-leaf defoliation, internal competition for assimilation of photosynthetic products is significantly reduced, allowing more assimilate to be transferred to seed development. This increase in photosynthetic activity leads to an increase in food reserves being passed on to the cob, which in turn increases the diameter and length of the corn cob.

Table 2. Time of detasseling effects on the number of seeds per cob and seed production per hectare

Detasseling Time	Number of Seeds per Cob (butir)	Seed Production per Hectare (ton/ha)
48 DAP	345,78 b	18,44 b
50 DAP	325,59 b	17,36 b
52 DAP	293,31 a	15,64 a

Notes: Numbers followed by the same notation in the same column show no significant difference in the 5% DMRT test

Based on Table 2. the detasseling time of 48 DAP gave the most optimal results in the number of seeds per cob of 345.78 grains and seed production per hectare of 18.44 tons/ha. As considered, It is because at the age of 48-50 DAP, plants have entered the generative phase of seed filling so that the results of photosynthesis can focus on the formation of food reserves in seeds that can be used as viable seeds. The findings of Shodikin in the research Shodikin & Wardiyati (2017) which said that detasseling can disrupt apical dominance and stop pollination in corn plants at the right age confirm this matter. Detasseling of female cobs should be carried out immediately because late detasseling will disrupt the genetic purity of the seeds expected in the crossing process between the two elders. Also, pollen on male plants in hybrid maize is not used to pollinate female flowers. If this matter is ignored, the dead corn cobs will be able to absorb photosynthetic products which will indirectly interfere with the quality of the seeds produced (Shodikin & Wardiyati, 2017). According to Sirih *et al.* (2021), male flower pruning can improve maize seed quality and seed production. Detasseling, also known as male flower pruning in hybrid seed production, aims to stop pollination and fertilization of female plants to accelerate cob development so that cobs can be harvested at the same time, increase production and quality, and direct photosynthesis towards cob development (Virgen-Vegas, 2016). Pollination is prevented by detasseling, which diverts energy that would otherwise be used for male flower blooming and pollination to increase the number of new maize cobs and fill the cobs produced by female plants.

Table 3. Effect of defoliation on the number of seeds per cob and seed production per hectare

Defoliation	Number of Seeds per Cob (grains)	Seed Production per Hectare (ton/ha)
No Defoliation	309,41 a	16,50 a
2 Leaves	314,44 a	16,77 a
4 Leaves	340,82 b	18,17 b

Notes: Numbers followed by the same notation in the same column show no significant difference in the 5% DMRT test

Based on Table 3. Defoliation of 4 leaves gave the highest results in the number of seeds per cob 340.82 grains and seed production per hectare 18.17 tons/ha. This indicates that defoliation of 4 leaves is effective in increasing the number of maize production yields. Cutting the leaves under the corn cob can help the plant to collect photosynthesized assimilated materials so that they can concentrate on filling the seeds (Sumajow *et al.*, 2016). According to Ren *et al.* (2022), the more photosynthate allocated to the cob, the more food reserves are accumulated and translocated to seeds, thus increasing seed weight. In contrast, the less photosynthate allocated to the cob, the less food reserves accumulated and translocated to seeds, thereby reducing seed weight. To maximize photosynthesis yields for seed filling, the leaves under the cob are cut so that they no longer take photosynthesis yields. This is based on the findings of Bustaman (2004) that the upper quarter of the leaf is very important for seed filling. Alkan growth is concentrated on seed and cob filling during the post-pollination stage. Leaves at the bottom of the cob should be removed as they will compete with the cob in the post-pollination period of the maize plant (Yulianto *et al.*, 2019). Maize leaves can be trimmed to improve the performance of the remaining leaves. When the light intensity is high during the rapid seed-filling phase in cereal crops, removing some leaves will increase the photosynthetic rate of the remaining leaves. The leaves closest to the cob are also the most active leaves during seed filling. Due to reduced light absorption, lower leaves have a lower photosynthetic capacity than upper leaves. When leaves are not actively photosynthesizing, they will develop into sinks and eventually compete with other plant parts for photosynthesis.

The results showed that defoliation and defoliation time had a significant effect, but the effect on corn cob diameter was not much different between treatments. This may be due to the fact that defoliation or pruning of leaves under the cob and defoliation time in pruning of male flowers were carried out when the corn was in the final generative phase, which was between 50-60 DAP, where in this phase all leaves had formed and fully opened. At this stage, cob formation was relatively stable and almost reached its peak, so that the treatment did not have a significant effect on affecting cob diameter. In addition, in this generative phase, the assimilation transport process was more focused on filling seeds and forming cobs that had formed optimally, so that changes in vegetative parameters such as leaf size or defoliation no longer had a significant impact on the enlargement of cob diameter. In other words,

although defoliation and defoliation can affect the distribution of assimilation during the vegetative phase or early cob formation, in the final generative phase, the effect becomes more limited, especially on the size of the cob diameter.

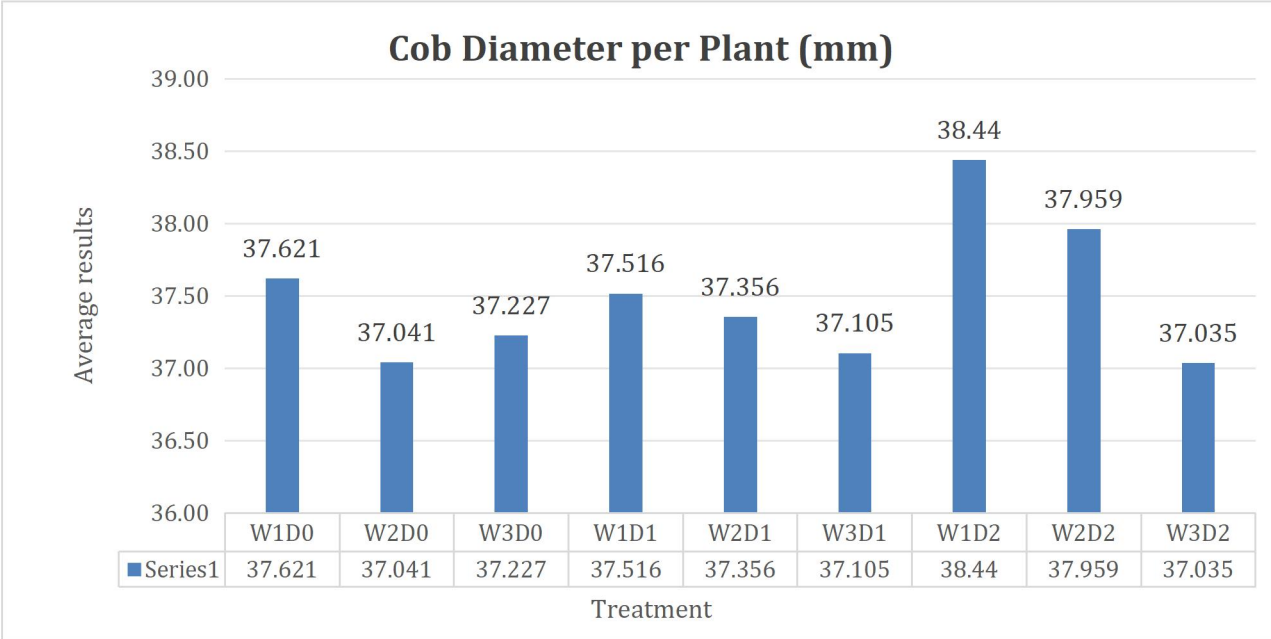

Figure 1. Average results of the effect of detasseling and defoliation time on cob diameter

Figure 1 shows the average cob diameter gives relatively similar results to all treatments. The defoliation treatment did not significantly affect the length and diameter of the cob. Cob length is less susceptible to leaf pruning therapy (Heidari, 2013). This is because pruning has only minimal impact on plant organ growth at this point and cob elongation is most likely already completed at the wrapping stage. In addition, there was no significant difference in cob diameter between pruning techniques. Sweet corn plants entering the reproductive and fruiting period should exhibit good morphological conditions, such as good leaf, root, and stem growth, to ensure the formation and multiplication of seeds and cobs. Ensuring sufficient light for photosynthesis is essential to maintain the morphology that emerges during the growth phase. If there is not enough light, plants such as flowers and corn will not thrive. In addition, its effect on the number of seeds produced increases as the diameter of the sweet corn cob increases. Wahyudi *et al.*, (2016) found a positive correlation between the number of rows of seeds produced and the diameter of the corn cob.

CONCLUSION

The treatment of 48 DAP detasseling time gave the best results in cob weight of 68.11 g, number of seeds per cob of 345.78 grains, and seed production per hectare of 15.64 tons/ha. The treatment of defoliation of 4 leaves gave the best results in cob weight of 69.17 g, cob length of 14.77 cm, number of seeds per cob of 340.82 grains, and seed production per hectare of 18.18 tons/ha. The interaction of defoliation of 4 leaves and detasseling time of 48 DAP gave the best value on the weight of the cob without kelobot of 78.55 grams, the length of the cob per plant 14.97 cm.

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