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Effect of type of seedling media and duration of synthetic auxin immersion on germination and initial growth of papaya (*Carica papaya*) seedlings

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Abstract. *Mulati A, Supriyono, Wiryowidodo W. 2017. Effect of type of seedling media and duration of synthetic auxin immersion on germination and initial growth of papaya (*Carica papaya*) seedlings. Cell Biol Dev 1: 64-70.* Papaya (*Carica papaya* L.) is a well-known fruit plant with high economic value. The uniformity of germination and initial growth must be considered to get normal mature plants. Using appropriate seedling media and synthetic auxin can support the germination and initial growth of papaya seedlings. This study aimed to determine the effect of the type of seedling media and the duration of immersion of synthetic auxin, and the combination that had a positive effect on germination and initial growth of papaya seedlings. This research was conducted in Badranrejo, Kemiri, Mojosongo, Boyolali, and the Laboratory of the Faculty of Agriculture, Sebelas Maret University, Surakarta, from April to July 2009. This study used a Completely Randomized Design (CRD) with two treatment factors and three replications. The first factor was the type of seedling media: soil, soil + farmer-produced cow manure (1:1), soil + self-produced cow manure (1:1), and soil + farmer-produced cow manure + self-produced cow manure (1:1:1). The second factor was the immersion time in synthetic auxin: 0 hours, 1 hour, 2 hours and 3 hours. Data were analyzed by analysis of variance and if there was a significant difference, proceed with DMRT 5%. The results showed that the interaction between seedling media and immersion time in synthetic auxin did not occur. Therefore, adding cow manure as a medium is unnecessary, especially for papaya seed germination. Synthetic auxin immersion from 1 to 3 hours did not increase all variables of germination and initial growth of papaya seedlings.

Keywords: Auxin, *Carica papaya*, papaya, seedling media

INTRODUCTION

Papaya (*Carica papaya* L.) is a well-known fruit plant with high economic value. Therefore, the plant is suitable for planting in the tropics and subtropics (da Silva et al. 2007). The flesh of the plant is soft with red or yellow color. It tastes sweet and refreshing because it contains a lot of water. The nutritional value of this fruit is quite high because it contains a lot of provitamin A, vitamin C, and calcium minerals (Kalie 1983).

According to Kalie (2003), papaya plant propagation can be done by grafting, layering, or seeds. However, grafting propagation is rarely done by farmers or seed breeders because it requires plants for rootstock in large quantities. Propagation by grafting has also not been widely applied considering the relatively difficult implementation; therefore, seed propagation is the easiest alternative to propagate this fruit plant. Seeds can be planted directly in the garden, nursery, or polybag. However, in this seed propagation, the germination time is often not the same, so the plants are not grown simultaneously.

Root formation is a very important initial factor in germination. Seeds with roots will have the ability to grow better. One of the factors that can affect the formation of roots is the seedling medium. Seedling media is a place to germinate seeds. Seedling media for germination must meet the requirements, including crumb structure, namely a balanced ratio of micro and macro pores so that it does not inhibit root growth and can bind water and nutrients needed for plant growth. Several types of media can be used as a germination medium. Each type of media has different characteristics, so it is necessary to look for it to get a suitable growing medium for a plant. Not many papaya seed growers in Indonesia, especially in Boyolali, know the right seedling media for the germination and growth of papaya seeds. So it is because there is not much information about the right media for germination and growth of papaya seeds.

The success of germination is not only influenced by the seedling media but also by external stimuli that stimulate roots, for example, by giving growth regulators. Growth regulators are organic compounds that are not nutrients, which in small amounts can support, inhibit, and can change plant physiological processes (Abidin 1994). For example, according to Koesriningroem and Setyati (1979), one growth regulator type is auxin, which can stimulate cell elongation. Auxin initiates cell elongation by influencing the relaxation or flexibility of the cell wall. As a result, cell elongation will cause stem and root elongation. Auxins are produced naturally by plants, such as IAA (indoleacetic acid) and IBA (indolebutyric acid). In contrast, auxins produced by companies are called synthetic auxins, such as NAA (naphthalene acetic acid) and 2,4 D (2.4 dichlorophenoxyacetic acids).

One type of synthetic auxin sold in the market is atonic. Atonic is a trademark and contains growth regulators that can stimulate root growth and accelerate seed germination. However, this atonic is only effective during immersion. According to Danusastro (1973), the method of giving growth regulators can be immersion, spraying, smearing, and others. Fresh seeds can be soaked in a solution of vitamin B1 or a solution of growth regulators for 30 minutes, while for dry seeds, the minimum immersion time is 2 hours.

The aims of this study were: (i) to determine the interaction between the type of seedling medium and the duration of immersion in a synthetic auxin in its effect on germination and growth of papaya seedlings; (ii) to determine the seedling media that gives the best effect on the uniformity of germination and growth of papaya seedlings; (iii) to determine the duration of immersion in a synthetic auxin which gives the best effect on the uniformity of germination and growth of papaya seedlings.

MATERIALS AND METHODS

Place and time of research

The research was conducted in April-July 2009 at Badranrejo, Kemiri, Mojosongo, Boyolali with an altitude of 228 m above sea level and in the Laboratory of the Faculty of Agriculture, Universitas Sebelas Maret, Surakarta, Central Java, Indonesia.

Materials and Tools

The research materials were plant seeds from local Papaya Boyolali (a Thai variety that has been adapted for a long time), soil, farmer-produced cow manure (purchased directly from farmers), and self-produced cow manure (fermented pure cow vesicles mixed with EM-4 and molasses). The research tools were polybag, ruler, scale, oven, label paper, masonry trowel, and stationery.

Research design

The study was arranged based on a completely randomized design (CRD) with 2 treatment factors. Factor I: type of seedling media (S1 = soil, S2 = soil: farmer-produced cow manure (1:1), S3 = soil: self-produced cow manure (1:1), S4 = soil: farmer-produced cow manure: self-produced cow manure (1:1:1). Factor II: immersion time (A1 = without immersion in atonic, A2 = immersion in atonic for 1 hour with a concentration of 1 ml/L, A3 = immersion in atonic for 2 hours with a concentration of 1 ml/L, A4 = immersion in atonic for 3 hours with a concentration of 1 ml/L. Based on these two factors, 16 treatment combinations were obtained. Each treatment combination contained 5 populations, and each combination was repeated 3 times so that there were 240 polybags as experimental units.

Research implementation

Media preparation

Prepare the soil, farmer-produced cow manure, and self-produced cow manure. Fill the plastic bag with the media according to the treatment. Farmer-produced cow manure was obtained from farmers directly by buying, and self-produced cow manure was obtained by fermenting pure cow feces mixed with EM-4 and molasses.

Seed preparation

The seeds came from fruit that was old or ripe on the tree. The fruit was split; the seeds were taken and located in the center of the fruit. Seeds were cleaned from the thin layer using kitchen ash, washed, and dried under the sun for 2 days.

Preparation and immersion in atonic

One (1) mL of atonic was diluted with distilled water until the volume reached 1 L and then shaken until homogeneous. After that, the dried seeds were immersed in the atonic solution according to the treatment.

Seeding

After being immersed in an atonic, seeds were sown in polybags filled with seedling media according to treatment. Then, the seedling media was perforated as deep as 1 cm, the seeds (2 seeds each) were inserted, and the holes filled with seeds were covered with a little seedling media.

Upkeeping

Plant upkeep included watering, weeding, and controlling pests and disease-causing agents. Watering was done every day (morning or evening). Weeding was carried out on weeds growing around the plant. Controlling of pests and disease-causing agents was carried out.

Observation variable

Germination

Germination rate. Count the number of normal germination on the fourteenth day after the seeds germinated, then calculate the germination rate percentage. The germination rate can be calculated using the formula:

Germination Rate (GR) = (number of normal germination on day 14/total number of seeds) x 100%

Germination capability. Count the number of normal germinations on the twenty-first day after the seeds germinated, then calculate the germination percentage. Germination capability can be calculated using the formula:

Germination capability (GC) = (number of normal sprouts on day 21/total number of seeds) x 100 %

Germination uniformity. Germination uniformity was measured by calculating the addition of the highest percentage of seeds that grew normally compared to the previous day.

Growth

Root length (cm). Measure the root length from the base to the tip of the root. Take measurements at the end of the study.

Stem circumference (cm). Calculate the circumference of the stem by wrapping a thread around the seedling. Measurements were made approximately 5 cm from the root neck of the seedling.

Plant height (cm). Measure the height of the seedling from the root neck to the growing point. Perform once-a-week observation on plant height (cm) after the seeds were one week old until the end of the study.

Number of leaves (strand). Count the number of leaves that have opened completely. Observations once a week after the seeds were 1 week after germination until the end of the study.

Leaf area (cm^2). Calculate leaf area using the gravimetric method at harvest. The calculation is as follows:

Leaf area = Wr/Wt x Lk

Where:
Wr : Replica paperweight
Wt : Total paper weight (3.5 g)
LK : Total paper area (710.64 cm^2)

Total seedling fresh weight (g). Weigh the fresh weight of the seeds, including the roots, stems, and leaves, at the end of the study.

Total seedling dry weight (g). Weigh the seeds' dry weight, including the roots, stems, and leaves, after drying in an oven at a temperature of 60-70ºC for ± 24 hours until the weight is constant.

Data analysis

Analysis of Variance (Anova) analyzed observational data, and if there was a significant difference, it was continued with Duncan's Multiple Distance Test (DMRT) at a 95% confidence level.

RESULTS AND DISCUSSION

Germination rate

Germination rate is a measure of seed vigor which states the number of days required for the emergence of the radicle/plumule (Mugnisjah and Setiawan, 1990).

The analysis of variance showed no interaction between the type of seedling media and the immersion time of synthetic auxin on the germination rate. However, the type of seedling media had a very significant effect on the rate of germination of papaya seeds. At the same time, the immersion time of synthetic auxin did not significantly affect the papaya seeds' germination rate.

Table 1 (DMRT 5%) shows that soil media has the best effect on papaya seeds' germination rate. It is presumably because the soil moisture is maintained so that there is a critical point of germination. If there is a critical point of germination, seeds will be hydrolyzed. Seed germination begins with the absorption of water. In absorption, water imbibition will cause the seed coat to soften. By softening the seed coat, the elements needed for seed germination can enter the seed easily.

Germination power

Germination is the percentage of the number of seeds that grow normally in a predetermined period. According to Mugnisjah and Setiawan (1990), germination is a seed viability measure that predicts seeds' potential viability.

The results of the analysis of variance showed that there was no interaction between the type of seedling media and the immersion time of synthetic auxin on germination. The seedling media had a very significant effect on the germination of papaya seeds, while the immersion time of synthetic auxin did not significantly affect the germination of papaya seeds.

Table 2 (DMRT 5%) shows that the soil medium had the best effect on the germination of papaya seeds. Presumably, the seeds used were physiologically ripe, where the moisture content decreased rapidly to about 20%. Under these conditions, the seeds had maximum dry weight, growth, and germination (Kamil 1979). Therefore, high germination indicates the high viability of the seed. In addition, high germination will save on using seeds and costs incurred for purchasing seeds.

Physiologically ripe seeds can be obtained from fruit that has reached a maturity level of 99% or is commonly referred to as ripe. It can be seen visually from the color of the fruit, which has become reddish yellow in almost all parts of the fruit (Kamil 1979).

Table 1. The average germination rate in the treatment of various types of media for seedlings of papaya seeds 10 WAP

Seedling media	Average (%)
S1:soil	0.26 a
S2:soil:farmer-produced cow manure (1:1)	0.03 b
S3:soil:farmer-produced cow manure (1:1)	0.17 a
S4:soil:farmer-produced cow manure:self-produced cow manure (1:1:1)	0.04 b

Note: Numbers followed by the same letter show no significant difference in DMRT 5%

Table 2. Average germination of various types of seedling media on papaya seeds at 10 WAP

Seedling media	Average (%)
S1:soil	0.32 a
S2:soil:farmer-produced cow manure (1:1)	0.07 b
S3:soil:farmer-produced cow manure (1:1)	0.28 a
S4:soil:farmer-produced cow manure:self-produced cow manure (1:1:1)	0.08 b

Note: Numbers followed by the same letter show no significant difference in DMRT 5%

Germination uniformity

The uniformity of germination in a seed depends on the vigor of a seed. Vigor can be interpreted as the ability of seeds to grow normally in suboptimal environmental conditions (Sutopo 2002). Therefore, with high uniformity, it is expected to produce normal mature plants so that production can be optimal.

The analysis of variance showed no interaction between the type of seedling media and the immersion time of synthetic auxin on the uniformity of papaya seed germination. The type of seedling media and the duration of immersion in synthetic auxin did not significantly affect the uniformity of papaya seed germination.

Figure 1 shows that treatment with soil media with seeds soaked in synthetic auxin for 3 hours provided the best germination uniformity compared to other treatments. The germination uniformity depends on vigor. Vigor is synonymous with germination rate. If the germination rate is high, the vigor is also high. It can be seen that the variable rate of germination of soil media gives the best effect compared to other media. High seed vigor usually lasts a long time for storage, is resistant to pests and disease-causing agents, grows quickly and evenly, and can produce normal mature plants that produce well in a suboptimal growing environment. High seed vigor can achieve high production levels (Sutopo 2002).

Root length

Roots are an integral part of the plant and have the same important function as the top of the plant. For example, in the process of photosynthesis, the upper part of the plant, in the form of a canopy, functions to absorb CO^2 to carry out the photosynthesis process, while the lower part, in the form of roots, functions to absorb water and nutrients (Sitompul and Guritno 1995).

The analysis of variance showed no interaction between the type of seedling media and the immersion time of synthetic auxin on the root length of papaya seedlings. However, the seedling media had a very significant effect on the root length of papaya seeds. At the same time, the duration of immersion in synthetic auxin did not significantly affect the root length of papaya seeds.

Root length is one parameter that indicates a plant can grow well. Long roots indicate that the plant is growing actively because plant roots grow elongated, looking for water and nutrients. In addition, long roots indicate that the plant's growing medium is less fertile. Table 3 shows that soil media has the best effect on the root length of papaya seedlings compared to other seedling media. It is suspected that the soil used has little nutrient content, per Sutejo's (2002) statement that the organic matter content in the regosol soil is low, causing plant roots to grow lengthwise looking for water and nutrients for water photosynthetic activity. Per Wahyudi (2009), root length growth is influenced by the availability of little nutrients, causing the roots to elongate in search of nutrients. In addition, Gardner et al. (1991) stated that roots that penetrate deep into the soil might grow into unexploited soil layers, which generally have low mineral content.

Table 3. Average root length in the treatment of various types of seedling media on papaya seedlings at 10 WAP

Seedling media	Average (%)
S1:soil	19.93 a
S2:soil:farmer-produced cow manure (1:1)	10.15 bc
S3:soil:farmer-produced cow manure (1:1)	17.63 ab
S4:soil:farmer-produced cow manure:self-produced cow manure (1:1:1)	5.83 c

Note: Numbers followed by the same letter show no significant difference in DMRT 5%

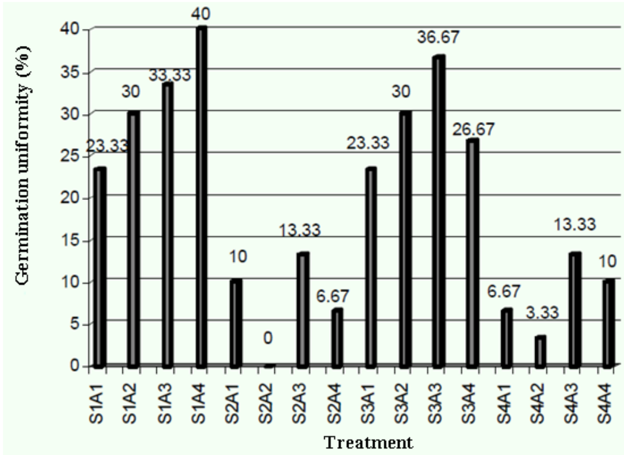

Figure 1. Germination uniformity of papaya seedlings at 10 WAP

Stem circumference

Stem circumference will show the robustness of the seedling so that it shows the ability of the seedling to support the canopy above it. Ashari (1995) added that the stem supports the growth of leaves, flowers, and fruit and is a storage place for food, water, and minerals.

The results of the analysis of variance showed that there was no interaction between the type of seedling media and the immersion time of synthetic auxin on the stem circumference of papaya seedlings. The type of seedling media and the duration of immersion in synthetic auxin did not significantly affect the increase in stem circumference of papaya seedlings.

The size of the stem circumference indicates the growth process as a result of cell enlargement and differentiation. It is influenced by the absorption of water (H_2O) and nutrients from the soil by plants to form plant tissues and organs. In addition, it is also influenced by the photosynthesis process, which will result in the accumulation of photosynthesis in plant organs (Mardani 2008).

Based on Figure 2, it can be seen that the mixed media of soil and self-produced cow manure and synthetic auxin soaking for 3 hours had a good effect on the stem circumference of papaya seedlings. With this media, stem circumference from week to week increased compared to other media. It is suspected that the mixed media of soil and self-produced cow manure is a porous medium, so the water absorption is good, and the water needed for the photosynthesis process can be fulfilled. According to Lakitan (2004), a plant's photosynthesis rate is limited by the availability of water. Therefore, lack of water can inhibit the rate of photosynthesis, especially its effect on the turgidity of stomata guard cells. If there is a lack of water, the turgidity of guard cells will decrease, causing the stomata to close. The closing of the stomata will inhibit the absorption of CO_2, which is needed for carbohydrate synthesis.

Plant height

Plant height is a plant size that is often observed either as a growth indicator used to measure environmental effects or the treatment applied and is the easiest to see (Sitompul and Guritno 1995).

The results of the analysis of variance showed that there was no interaction between the type of seedling media and the immersion time of synthetic auxin on the growth of papaya seedling height. The type of seedling media and the duration of immersion of synthetic auxin did not significantly affect the increase in height growth of papaya seedlings. It is presumably due to the unpreparedness of the nutrients in the seedling medium for plants, even though the amount is high. Sutejo (2002) stated that although N, P, and K are in the soil, not all of them are ready to be absorbed by plants.

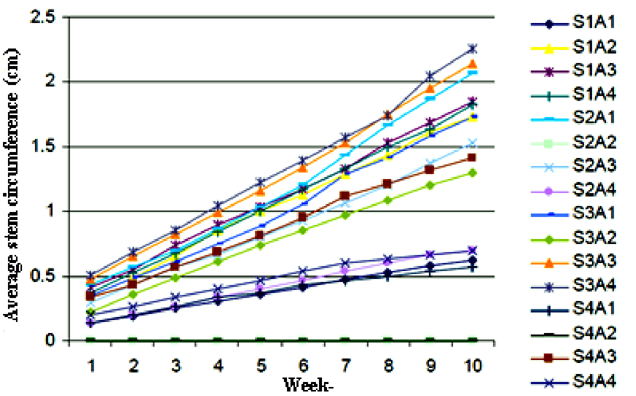

Figure 2. Stem circumference of papaya seedlings at 10 WAP

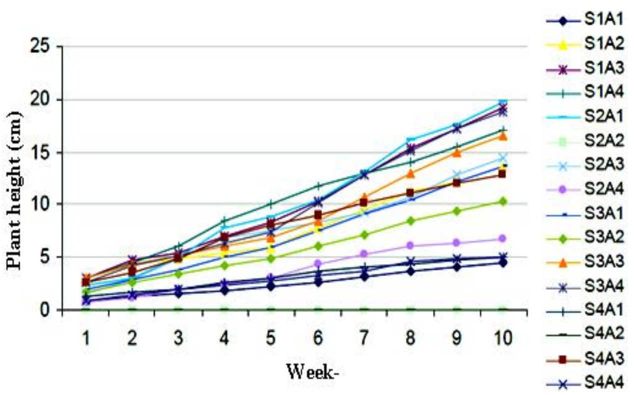

Figure 3. Papaya seedling height at 10 MST

Figure 3 shows that the soil media treatment mixed with farmer-produced cow manure and without immersion in atonic resulted in the highest plant height compared to other treatments. Therefore, the soil media mixed with farmer-produced cow manure is suspected of containing a high total N (see appendix). In the presence of high N, plant growth can increase. Furthermore, Sutejo (2002) states that nitrogen is the main nutrient for plant growth, which is generally required for the formation or growth of vegetative parts of plants, such as leaves, stems, and roots.

The use of synthetic auxin growth regulators in papaya nurseries aims to stimulate seedling growth so that the seeds produced are fast and uniform in growth so that they are always ready for planting on time and can produce normal and high-producing mature plants even in suboptimal growing conditions. One thing to be aware of is that growth substances do not always have a good effect on plant growth, but sometimes they inhibit plant growth. Somantri and Evizal (1987) cit. Murni (1994) suggested that the growth stimulant sodium nitrophenol was less effective because it was not much different from that without a growth stimulant.

Number of leaves

Leaves are generally the site of carbohydrate synthesis for plants. Therefore, leaf observation is necessary as an indicator of growth and as supporting data to explain the growth process. The number of leaves is one of the variables that can be used to measure plant growth other than plant height (Sitompul and Guritno 1995).

The analysis of variance showed no interaction between the type of seedling media and the duration of immersion of synthetic auxin on the number of leaves. However, the type of seedling media had a very significant effect on increasing the number of papaya seed leaves. In contrast, the duration of immersion in synthetic auxin did not affect increasing the number of papaya seed leaves.

Table 4 shows that soil media has the best effect on the number of papaya seedling leaves compared to other seedling media due to the medium total N content in soil media, namely 0.35%. Sufficient N content can affect the formation of plant vegetative parts, in this case, the leaves. According to Gardner et al. (1991), if the plant lacks N, the growth process will be disrupted, the plant will be stunted, the plant leaves will turn yellow and then fall off, and the dry weight of the crop will decrease. The yellowed leaves then fall off, reducing the number of leaves present.

Table 4. The average number of leaves in the treatment of various types of media for seedlings on papaya seedlings at 10 WAP

Seedling media	Average (%)
S1:soil	8.72 a
S2:soil:farmer-produced cow manure (1:1)	3.75 b
S3:soil:farmer-produced cow manure (1:1)	8.22 a
S4:soil:farmer-produced cow manure:self-produced cow manure (1:1:1)	2.12 b

Note: Numbers followed by the same letter show no significant difference in DMRT 5%

The content of N can affect the formation of vegetative parts of plants, but it can also be influenced by aeration that occurs in the soil media. Although the soil used as the media is regosol soil, it is suspected that the regosol soil used has better aeration than other media. Good aeration will facilitate the absorption of nutrients.

Leaf area

Leaf area is the main parameter concerning the function of leaves as light receivers and photosynthetic tools. Therefore, leaf area largely determines the rate of photosynthesis per unit plant. In other words, information about plant photosynthesis can be obtained (Sitompul and Guritno 1995).

The analysis of variance showed no interaction between the type of seedling media and the duration of immersion of synthetic auxin in the leaf area of papaya seedlings. The type of seedling media and the duration of immersion in synthetic auxin did not significantly affect the leaf area of papaya seedlings.

In Figure 4, it can be seen that papaya seedlings treated with a mixture of soil and farmer-produced cow manure and without synthetic auxin immersion were able to produce the highest leaf area compared to other treatments. In the mixed media of soil and farmer-produced cow manure, the N content is high, namely 0.70%. High N content can affect the leaf area of a plant. Sallah et al. (1998) cit Sulandjari (2008) stated that applying N can increase leaf area and photosynthetic activity. It is supported by Humphries and Wheeler (1963) cit. Gardner et al. (1991) stated that N fertilization significantly affected leaf expansion, especially on leaf width and area. Suppose there is more available N content than other elements. In that case, the carbon skeleton converted into protein as a protoplasm component will run faster to produce more protein (Sutedjo 2002). Humphries and Wheeler (1963) cit. Gardner et al. (1991) stated that N deficiency can also cause a reduction in leaf area due to the aging of lower leaves. It can be seen that the leaf area of papaya seeds with soil media alone has a lower leaf area than the other treatments. It is because the soil media used had moderate N content, so it was not sufficient for the vegetative growth of papaya seedlings.

Total seedling fresh weight

Growth is an activity that processes substrate inputs to produce growth products. The yield of growth products can be measured simply by the weight gain of the whole plant or plant parts, including the harvested part and other parameters (Sitompul and Guritno 1995). Salisbury and Ross (1995) added that the plant's fresh weight showed the plant's metabolic activity, and the fresh weight's value was influenced by tissue moisture content, nutrients, and metabolic products.

The analysis of variance showed no interaction between the type of seedling media and the duration of immersion of synthetic auxin on the total fresh weight of papaya seeds. The type of seedling media and the duration of immersion in synthetic auxin did not significantly affect the total fresh weight of papaya seeds.

Based on Figure 5, it can be seen that the mixed media of soil and farmer-produced cow manure could have the best effect on the total fresh weight of seedlings. The total fresh weight of seedlings is influenced by the size of the leaf area of a plant and by the accumulation of other parts of the plant, such as roots and stems, as well as the water content present in each part of the plant. As the leaf area increases, the leaf weight produced will also increase.

Therefore, high leaf weight will affect the total fresh weight of the plant. In the observation of leaf area, the largest leaf area was produced in a mixture of soil and farmer-produced cow manure, causing the total fresh weight of seedlings on the same medium to be high. Besides being influenced by leaf area, the total fresh weight of seedlings was also influenced by the availability of N in the media used. According to Harjadi (1991), the presence of N in the media could be absorbed by plant roots which could be utilized in the division and development of cells by plant tissues. It resulted in the formation of large vacuoles that can hold large amounts of water, thereby increasing the fresh weight of the plant.

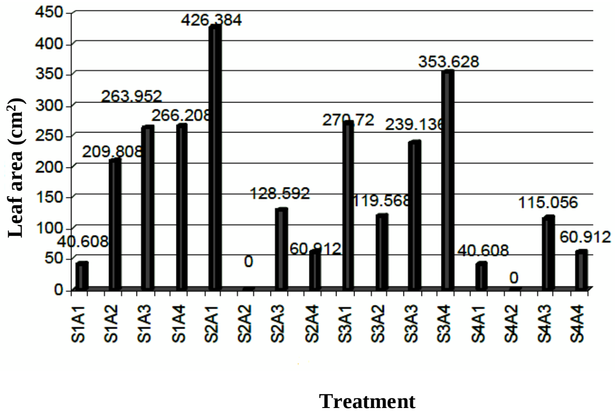

Figure 4. Papaya seedling leaf area at 10 WAP

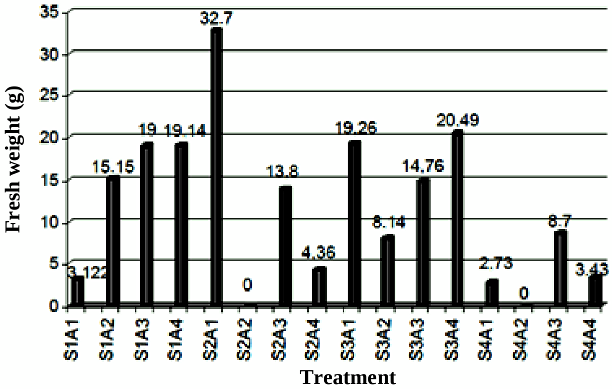

Figure 5. The total fresh weight of papaya seeds at 10 WAP

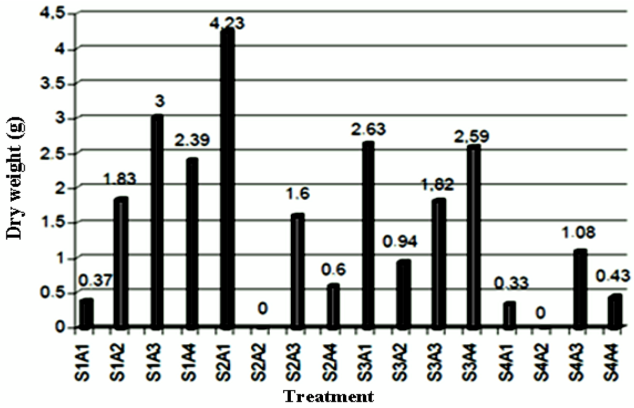

Figure 6. The total seedling dry weight of papaya at 10 WAP

Total seedling dry weight

The total dry weight of the plant shows the amount of organic matter accumulated or stored in the plant. Plant dry weight results in a balance between CO_2 uptake (photosynthesis) and excretion (respiration). Gardner et al. (1991) and Utama (1999) cit. Suryaningsih (2006) added that dry weight reflects the nutritional status of plants because dry weight depends on the rate of photosynthesis and plant respiration.

The analysis of variance showed no interaction between the type of seedling medium and the duration of immersion of synthetic auxin on the total dry weight of papaya seeds. The type of seedling media and the duration of immersion in synthetic auxin did not significantly affect the dry weight of the whole papaya seeds.

Figure 6 shows that the highest total dry weight of seeds was produced by a mixture of soil and farmer-produced cow manure. Dry weight is closely related to the fresh weight of a plant. If the fresh weight is high, the dry weight is also high. The increase influenced the dry weight of the plant in the leaf area of the plant. It is in line with the statement of Pujiasmanto (2001) that an increase in leaf area will increase the material obtained. Harjadi (1991) adds that the availability of nutrients absorbed by plants can stimulate the formation of carbohydrates, fats, and proteins through photosynthesis. Protein synthesis will result in an increase in the size of plant cells and the accumulation of carbohydrates in the form of dry weight that cannot be reversed.

In conclusion, based on the research, it can be seen that: (i) the interaction between the types of seedling media and the duration of immersion in synthetic auxin did not occur in all observed variables; (ii) the expected uniformity of germination through all combinations of treatments such as seedling media and synthetic auxin was not achieved; (iii) the use of soil media with the addition of farmer-produced cow manure and self-produced cow manure has not succeeded in increasing all variables of germination and early growth of papaya seedlings; (iv) synthetic auxin immersion for up to 3 hours did not increase all variables of germination and early growth of papaya seedlings.

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