THESIS

PENGARUH KOMPOSISI MEDIA TANAM DAN WAKTU PINDAH TANAM TERHADAP PERTUMBUHAN DAN HASIL TANAMAN SAWI PAGODA

THE EFFECT OF PLANTING MEDIA COMPOSITION AND TRANSPLANTING TIME TO THE GROWTH AND YIELD OF TATSOI

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SUMMARY

KIRANA LUTHFIA NAYATAMI. The Effect of Planting Media Composition and Transplanting Time to the Growth and Yield of Tatsoi (Supervised by **BENYAMIN LAKITAN** and **FIRDAUS SULAIMAN**).

The objective of this research was to determine the best planting media composition of soil, husk charcoal, and cow manure, and transplating time to the growth and yield of tatsoi. This research was conducted at Indralaya (-3º12'17"S 104º38'52"E), Ogan Ilir, South Sumatra. The research was carried out from November 2020 to January 2021. This research used Factorial Randomized Block Design method which consisted of 2 factors, i.e. planting media composition and transplanting time. The first factor was planting media composition (K) which consisted of 4 levels, i.e. K_0 = 9:1 (soil : cow manure), K_1 = 6:3:1 (soil : husk charcoal : cow manure), K_2 = 6:2:2 (soil : husk charcoal : cow manure), and K_3 = 6:1:3 (soil : husk charcoal : cow manure). The second factor was transplanting time (T) which consisted of 3 levels, i.e. T_1 = 7 DAS (days after sowing), T_2 = 10 DAS, and T_3 = 13 DAS. The total treatment consisted of 12 treatment combinations with 3 replications and each replication contained of 3 plants, so there were 108 experimental units. The data were analyzed by using the Anova test and followed by the LSD 5% test. The results showed that the planting media composition of soil, husk charcoal, and cow manure gave the best effect on growth and yield of tatsoi was in the ratio 6:2:2, which was based on the highest plant height, number of leaves, and canopy width, canopy area, leaf fresh weight, stem fresh weight, leaf dry weight, and stem dry weight. Transplanting time of 13 DAS gave the best effect on growth and yield of tatsoi, which was based on the highest number of leaves, canopy width, canopy area, leaf fresh weight, stem fresh weight, root fresh weight, leaf dry weight, root dry weight, shoot/root ratio and harvest index.

Keywords :*Tatsoi, husk charcoal, cow manure, planting time*

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This thesis was written to fulfill one of the requirements to accomplish S1 degree
at Faculty of Agriculture, Sriwijaya University

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APPROVAL SHEET

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Therefore, this statement is made consciously without any coercion from any party.

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BIOGRAPHY

The writer's full name is Kirana Luthfia Nayatami who was born in Lubuklinggau on February 14th, 2000. She is the first child of Mr. Bagus Surawijaya and Mrs. Sri Ekawati.

In 2017, she was registered as S1 student of Agronomy study program, Agricultural Cultivation Department, faculty of Agriculture, Sriwijaya University. Before continuing her study in the university, the writer started her education at SDN 120 Palembang from 2005 to 2011 and continued to SMP Xaverius 7 Palembang from 2011 to early 2013. Due to several reasons, she decided to transfer to SMP Xaverius Lubuklinggau and graduated from the school in 2014. Afterward she continued her study in SMA Xaverius Lubuklinggau from 2014 and graduated in 2017.

During the lecture period, the writer was a member of the Agronomy students association and also participated as a volunteer at the 2018 Asian Games. In 2019, she had the opportunity and been trusted as a Plant Physiology Practicum Assistant and in the same year she was selected as a student exchange scholarship recipient at Putra Malaysia University for one semester.

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Indralaya, April 2021

The writer

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CHAPTER 1
INTRODUCTION

1.1. The Background

Tatsoi is an Asian native plant from China (Jayati and Susanti, 2019). The shape of this plant resembles Pakcoy with spoon-shaped dark green leaves. Tatsoi stems are short and segmented with a light green color. This plant has a tap root system with elliptical root branches (cylindrical). (Gustianty and Saragih, 2020).

Tatsoi belongs to Brassicaceae family which contains A vitamin, C vitamin, E vitamin, K vitamin, folate, calcium, iron, potassium and phosphorus. Besides, Tatsoi also contains various glucosinolate compounds as an anti-cancer and microbial protein, such as glucoalyssin, gluconapin, glucobrassicanapin, 4-hydroxyglucobrassicin, dan progoitrin. This vegetable is also rich in fiber so it is good to be consumed as fresh vegetable (Hedges and Lister, 2006). High nutritional content and small number of farmers who cultivate it make Tatsoi has a fairly high price compared to other mustard greens that this vegetable has good prospects to be developed.

In cultivating Tatsoi, planting media is used to grow it and contains various materials and nutrients needed by plants. One of the planting media whose function is as a soil enhancer that is often used to increase plant production is husk charcoal. Husk charcoal is a porous and sterile growing medium derived from burned rice husks with incomplete combustion (Gustia, 2013).

The composition of husk charcoal is mostly occupied by SiO_2 which is 52% and C is 31% then followed by other components, namely Fe_2, O_3, K_2O, MgO, CaO, MnO, dan Cu in relatively small amounts and organic matter. Husk charcoal has a very light and coarse characteristic that increases air circulation due to the large number of pores. Other characteristics of husk charcoal are high water holding capacity, high pH (8.5-9.0), and can eliminate the effects of diseases, especially bacteria and weeds (Setyoadji, 2015).

The results of research by Akmal and Simanjuntak (2019) on Pakcoy showed that giving rice husk biochar 20 tons/ha could increase plant growth and yield, where in the application of biochar 20 tons/ha there was an increase in the number of leaves, leaf area, plant fresh weight, plant dry weight, and yields per hectare of 1.58 tons ha.

In cultivating Tatsoi, soil fertility is needed to obtain optimal results. One of the efforts to increase soil fertility is the provision of organic matter. The organic material that can be used is cow dung. A cow is able to produce solid manure as much as 23,6 kg/day so that there is an increase in the cattle population which will increase the waste product. If the waste is not managed properly, it has the cause environmental pollution. (Sanusi *et al.*, 2015).

Cow dung cultivation into manure is able to supply nutrients needed by plants, increase soil microbiological activity, increase the value of cation exchange capacity, improve water absorption, increase water holding capacity, and improve soil structure (Mintarjo *et al.*, 2018). The nutrients contained in cow manure are 2,33 % N, 0,61 % P_2O_5, 1,58 % K_2O, 1,04 % Ca, 0,33 % Mg, 179 ppm Mn and 70,5 ppm Zn (Andayani and Sarido, 2013). The result of Fikdalillah *et al.* (2016) showed that giving 60 ton/ha cow manure on Chinese cabbage could increase the production of the Chinese cabbage.

Tatsoi is propagated through seeds and nurseries so that the transplanting time is carried out at the right plant stadia. The exact time of transplanting is determined by the type of plant, cultivar, and environmental conditions where the transplanting is carried out. Planting done with a controlled environment under the shade allows transplanting to be carried out earlier than transplanting in open land (Adnan, 2018).

Inappropriate transplanting seeds can cause stagnation that affects plant growth. Therefore, the right age of seedlings is needed so that the plants are able to adapt to the environment and accelerate the growth process. The research result on Pakcoy, transplanting ages 8 DAS, 10 DAS and 12 DAS gave the results that were not significantly (Murtiawan *et al.*, 2018).

From the description above, this study was conducted to find out the composition of soil planting media, husk charcoal, cow manure and the best transplanting time for the growth and yield of Tatsoi.

1.2. The Objective

This study aimed at finding out the composition of soil, husk charcoal, cow manure as planting media and the best planting time to the growth and yield of Tatsoi.

1.3. Hypothesis

It was suspected that the composition of soil, husk charcoal, cow manure (6:2:2) and transplanting time (DAS) was the best combination to the growth and yield of Tatsoi.

CHAPTER II
LITERATURE REVIEW

2.1. Tatsoi

Tatsoi (*Brassica narinosa* L.) has similar name to mustard spinach or spoon mustard, which is a leaf vegetable that is widely cultivated in Asia, especially in China. This plant belongs to Cruciferae family (Brassicaceae) such as cabbage, cauliflower, broccoli and radish so that it has a similar plant morphological character, including its stem, roots, flowers, fruit and seeds (Gustianty and Saragih, 2020). Tatsoi contains high nutrition which includes 1,51 mg B complex vitamins, 9900 IU A vitamin, 2,2 g protein, 210 mg calcium, 3,9 g carbohydrates, 11 mg magnesium, 449 mg potassium, and glucosinolic acid (Nugroho and Handoko, 2019).

According to Nugroho and Handoko (2019), Tatsoi belongs to Brassicaceae family which has the following classification.

Kingdom	: Plantae
Division	: Magnoliophyta
Class	: Magnoliopsida
Order	: Brassicales
Family	: Brassicaceae
Genus	: Brassica
Spesies	: *Brassica narinosa* L.

Tatsoi shape is similar to Pakcoy with flat rosette close to dark green ground and spoon-shaped leaves. Tatsoi stem is light green, short and segmented. Tatsoi structure is arranged in flower stalks (*inflorescentia*) that grow elongated (tall) and branched a lot. Each Tatsoi flower consists of four petals, four petals of bright yellow flower, four stamens and one pistil which has two hollow. Tatsoi has a tap root system with elliptic (cylindrical) root branches that spread in all directions with a depth of between 30-50 cm. (Cahyono, 2003).

This plant grows well in temperate or sub-tropical climates, where its development increases in hot or tropical areas. The best climate is in the area with a night temperature of 15.6°C and a day temperature of 21.1°C, with 10-15 hours of sun exposure per day. Tatsoi is best bred at an altitude of 5 m-1.200 m above sea level. This plant grows well on sandy loam type soils, such as Andosol soil, where the soil is fertile, loose, high in organic matter, dry and the soil air conditioning is good with an optimum soil pH of 6-7 (Gustianty and Saragih, 2020).

2.2. Husk Charcoal

Surdianto *et al.* (2015) states that husk charcoal is one of the materials that is often used as agricultural raw material. Farmers use husk charcoal as planting and nursery media, compost and soil loosening material, bokashi, and takakura. The raw material for husk charcoal is rice husk which can be found in rice mills. 20-30% of the rice milling process will be disposed in the form of rice husks. In rice production centers, rice husks are often seen piling up in rice mills and become a problem for factory owners because in some places rice husks are considered as waste.

Table 2.1. Quality of husk charcoal from combustion

Quality Components	Quality
Husk water content (%)	10,05
Husk yield (%)	75,46
Water content of husk charcoal (%)	7,35
Husk ash content (%)	1,00
Production time (hour)	2,00
Combustion capacity (kg/jam)	15,00

Source: Surdianto *et al.*, 2015

Some functions of rice husk charcoal are to improve soil structure and increase the soil ability to hold nutrients and water. Rice husk charcoal has a more crumbly nature than other growing media (Adhelina, 2018), and the black color can absorb sunlight effectively (Setyoadji, 2015). The use of rice husk charcoal will increase the weight of the soil volume (*bulk density*), so that the soil is not dense because it has many pores. These conditions will increase the total pore space of the soil and can accelerate groundwater drainage (Kusuma *et al.*, 2013).

Another advantage of husk charcoal is that it does not carry pathogenic microorganisms because the manufacturing process is through combustion so it is relatively sterile. In addition, husk charcoal also does not contain salts that are detrimental to plants. Husk charcoal contains essential nutrients that are important for plants such as nitrogen (N), phosphorus (P), potassium (K), calcium (Ca), magnesium (Mg), and it is rich in carbon content which is needed in making compost. From several studies, it was also known that the ability of husk charcoal as an absorbent is able to reduce the amount of harmful metals and pathogenic microbes in the composting process so that it produced compost which is free from harmful chemicals and diseases. (Surdianto *et al.*, 2015).

The research results of Adhelina (2018) showed that giving 500 g/plant rice husk charcoal with 500 g/plant chicken manure was the best treatment for the growth and yield of flower cabbage which was reflected in the variables of leaf number, flowering age, harvest age, total fresh weight of plants and the commercial fresh weight of flower cabbage. The study conducted by Naimnule (2016) found that the growth of Mung beans treated with husk charcoal and cow manure was better than those which were not treated with husk charcoal and cow manure. The highest yield of mung bean was obtained in the treatment of giving husk charcoal and cow manure as much as 5 tons/ha. Meanwhile, in long beans, giving the rice husk charcoal was able to increase the growth and development of long beans for the plant height parameters, plant conscious weight and fruit weight per plot (Zulputra, 2019).

2.3. Cow Manure

Manure is defined as all waste products from livestock that can be used to add nutrients and improve soil physical and biological properties. Manure is livestock manure in the form of solids including manure that has not been composted or has been composted as a source of nutrients, especially N for plants and can improve the chemical, biological and physical properties of the soil (Hartatik and Widowati, 2006). Beside improving the chemical, biological and physical properties of the soil, manure also contains various nutrients which can be seen in Table 2.2.

Table 2.2. Nutrient Content of Some Manure

Manure source	N (ppm)	P (ppm)	K (ppm)	Ca (ppm)	Mg (ppm)	S (ppm)	Fe (ppm)
Dairy cows	0,53	0,35	0,41	0,28	0,11	0,05	0,004

Sapi daging	0,65	0,15	0,30	0,12	0,10	0,09	0,004
Horse	0,70	0,10	0,58	0,79	0,14	0,07	0,010
Poultry	1,50	0,77	0,89	0,30	0,88	0,00	0,100
Sheep	1,28	0,19	0,93	0,59	0,19	0,09	0,020

Source: Hartatik and Widowati, 2006

Cow dung is widely used to be processed into manure because its availability is more than other animal manure (Suryono, 2018). Cow dung is one of the potential materials as raw materials in the manufacture of organic fertilizers. An average cow is able to produce manure in the range of 2.6-3.6 tons/year or the equivalent of 1.5-2 tons of organic fertilizer which can improve soil and reduce livestock waste and reduce the use of inorganic fertilizers (Huda and Wikanta, 2017).

Cow manure contains high fiber such as cellulose with 80% moisture content and 16% organic matter. Cow manure has a high C/N ratio which can suppress the growth of the main crop. The suppression of growth occurs because the activity of decomposer microbes will use the available N to decompose organic matter in the manure so that the main plants will be deficient in N. To maximize the use of cow manure, composting must be carried out so that it becomes ready-to-use cow manure compost with a C/N ratio below (Hartatik and Widowati, 2006).

In chili plants, the application of cow manure had a very significant effect on stem diameter and had a significant effect on plant height, number of fruits, fruit weight per plant, and productivity where the best chili plant growth and yield were found at a dose of cow manure as much as 30 tons/ha (Halim, 2013). Rokhim (2018) found that on mustard plants, a dose of cow manure as much as 30 ton/ha was able to optimize the growth of mustard plants.

2.4. Planting Time

One of the benefits of implementing transplanting is saving land during seeding. Seed beds occupy a small area at the time of sowing, thereby saving land area and increasing land use efficiency. Thus, transplanting is much more flexible than direct seeding in terms of the use of space and time during seeding (Ren *et al.*, 2014).

In the implementation of transplanting, the seeds that are sown will experience a process of damage, especially to the root system. This is closely related to the absorption and transpiration processes that take place at the same time. When transplanting is done, the plant will stop absorbing water while the transpiration process continues. Thus there will be a reduction in water in the plant seeds (Yudhistira *et al.*, 2014).

The age of transplanting has an influence on plant growth so that when transplanting at certain times it is necessary to know the suitability of the conditions for transplanting. It is still necessary to know further the effect of older or younger transplanting ages on plant growth when conditions allow for transplanting (Kaymak, 2009).

Ren *et al.* (2014) reported that in Canola (*Brassica napus* L.), the use of 40 DAS seeds could obtain better seed yields compared to younger and older seedlings. Meanwhile, in broccoli plants transplanting at the age of 30 DAS could increase crop yields (Kaymak, 2009). In flower cabbage, the combination of treatment using 6 DAS and 9 DAS seeds with a zig zag planting system gave higher cash productivity (Misromi and Suryanto, 2020).

CHAPTER III
METHODOLOGY

3.1. Place and Time

This study was conducted in the yard outside the campus which is located on di Jl. Raya Palembang-Prabumulih KM 32 (-3º12’17”S 104º38’52”E), Indralaya, Ogan Ilir, South Sumatera. Besides, it was conducted from November 2020 to January 2021.

3.2. Materials and Tools

The tools used in this study were 1) Stationery, 2) Jam bottle,3) Hoe, 4) Petri dish, 5) Bucket, 6) Hand sprayer, 7) Black cloth, 8) Filter paper, 9) Label, 10) Mortar, 11) Analytical balance, 12) Oven, 13) Ruler, 14) 5 kg Poly-bag, 15) Hose, 16) Smartphone, 17) SPAD, 18) Spectrophotometer, 19) Test tube, 20) Nursery Tray and 21) Waring.

The materials used in this study were 1) water, 2) Brown envelope, 3) Coarse husk charcoal, 4) Aceton, 5) Tatsoi seeds, 6) Topsin 500 SC fungicide with 500 g/L active Thiophanate-Methyl, 7) Cow manure, and 8) Soil (top soil).

3.3. Research Method

This study used Factorial Randomized Block Design consisted of 2 factors, namely planting media composition and transplanting time.

The first factor was planting media composition (K) consisted of 4 levels, as follows:

K_0 = 9:1 (soil : cow manure)

K_1 = 6:3:1 (soil : husk charcoal : cow manure)

K_2 = 6:2:2 (soil : husk charcoal: cow manure)

K_3 = 6:1:3 (soil : husk charcoal: cow manure)

The second factor is transplanting time (T), which consists of 3 levels, namely:

T_1 = Transplanting time 7 HSS

T_2 = Transplanting time 10 HSS

T_3 = Transplanting time 13 HSS

The total treatment consisted of 12 treatment combinations with 3 replications and each replication contained 3 plants, so there were 108 experimental units.

3.4. Data analysis

The data obtained were analyzed using the ANOVA test (analysis of variance) by comparing the calculated F with the F table to see the effect of the treatment. If F-count < F table, the treatment given had no significant effect. If calculated- F > F table at 5% test level, the treatment given had a significant effect (*). If F-count > F table at 1% test level, the treatment given had a very real effect (**). If F-count is real or very real, a further test would be tested using 5% Least Significance Different (LSD) to see the difference of each treatment. Statistical analysis was calculated by using Statistical Analysis Software (SAS).

3.5. Procedures

3.5.1. Research Site Preparation

The land used as research location was cleared of weeds and warring was put around the research site area.

3.5.2. Planting Media Preparation

The media used were top soil, husk charcoal, and cow manure. The soil was taken from ATC land, Faculty of Agriculture, Sriwijaya University, at the top soil with a depth of 30 cm. Husk charcoal was obtained from husk charcoal sellers in Palembang which has been processed from rice husks into husk charcoal. The cow manure used was the result of processing cow dung into manure at Animal Husbandry department, faculty of Agriculture, Sriwijaya University. Besides, the soil, husk charcoal, and cow manure were mixed with the composition according to the treatment then put into 5 kg poly-bags and labeled according to each unit treatment.

3.5.3. Seedling

The seeds used were Tatsoi seeds F1 Ta Ke Cai. Seeds were sown on the nursery tray containing soil planting media. Seeds that had been sown were watered every day.

3.5.4. Seeds Transfer to Poly-bags

Transplanting from nursery to poly-bags was done according to the treatment, i.e. at the age of 7 DAS, 10 DAS AND 13 DAS. Seedlings planted were in the same size.

3.5.5. Fertilization

The fertilizer applied was NPK 15:15:15 as much as 2 g per plant. Fertilizer was applied at 3 DAS by spreading fertilizer on the media surface.

3.5.6. Cultivation

Tatsoi cultivation included watering, weed control, and pest control. Watering was done every-day in the morning and evening. Weed control was done mechanically by pulling weeds that grew around Tatsoi. Pest control was also done mechanically by removing pests in Tatsoi. Disease control was carried out by giving the fungicide Topsin 500 SC with 500 g/L active Thiophanate-Methyl.

3.5.7. Harvest

Harvesting was done when Tatsoi was 52 DAS and 58 DAS and it was done by cutting the canopy of the plant.

3.6. Observed Variables

3.6.1. Plant height (cm)

Plant height was measured from the base of the stem to the shoot or the highest plant growth point using a ruler. Height measurements were carried out starting at 16 DAS with measurement intervals of once every 3 days.

3.6.2. Number of Leaves (strands)

Observation of the leaves number was done by counting the total number of leaves that had fully opened starting from 16 DAS with measurement intervals of once every 3 days.

3.6.3. Canopy Width (cm)

Measurement of canopy width was started from 16 DAS with a measurement interval of once every 3 days and done using a ruler by measuring the distance from one side of the canopy to the other by crossing the midpoint of the base of the stem then it was measured again using the same method from the perpendicular to the first measurement line. Furthermore, the two measurement results were averaged to get the value of the canopy diameter.

3.6.4. Canopy Area (cm^2)

The canopy area was measured by using *Easy Leaf Area* application on smartphone from 16 DAS with measurement intervals once every 3 days. Measurements are made by covering the area around the plant with a black cloth and then pointing the smartphone camera at the plant until the canopy was fully visible. At the same time, a square piece of red paper was placed with 4 cm^2 width.

3.6.5. Leaves Greenness Level

The measurements were done by using SPAD (Soil Plant Analysis Development) tool where the leaf whose greenish level was measured was clamped or inserted into the sensor part of the tool. Measurements were done on three sides of the leaf, namely the base of the leaf, the middle of the leaf and the tip of the leaf. Then, the three measurement results were averaged to get the greenish level of the leaves. This variable was measured when the plants were 17 DAS, 27 DAS, 38 DAS, 47 DAS, and at harvest.

3.6.6. Chlorophyll Analysis (mg/L)

Chlorophyll analysis was measured by a spectrophotometer at the age of 51 DAS and 57 DAS. The working steps were started by grinding 0.25 g of Tatsoi and extracted with 25 ml of 80% acetone. Furthermore, the extract was filtered using filter paper and put into a jam bottle. Before using it, the spectrophotometer was left for 15 minutes after the power was on. Besides, Tatsoi leaf extract was put into a test tube and the test tube was inserted into the spectrophotometer. Furthermore, absorbance or optical density (OD) was measured by using wavelengths 646 and 663 nm. After obtaining the absorbance value (OD), the chlorophyll content was calculated using the Lichtenthaler and Welburn method in the following equation.

$$\text{Total chlorophyll (mg/L)} = (17{,}3 \times OD_{646}) + (7{,}18 \times OD_{663})$$

$$\text{Chlorophyll a (mg/L)} = (12{,}21 \times OD_{663}) - (2{,}81 \times OD_{646})$$

$$\text{Chlorophyll b (mg/L)} = (20{,}13 \times OD_{646}) - (5{,}03 \times OD_{663})$$

3.6.7. Leaf Fresh Weight (g)

After Tatsoi was harvested, the leaves were separated from the stems and roots, and the fresh weight of the leaves was weighed by using an analytical balance.

3.6.8. Stem Fresh Weight (g)

The fresh weight of the stems that had been separated from the leaves and roots was weighed by an analytical balance.

3.6.9. Root Fresh Weight (g)

The fresh weight of roots that had been separated from leaves and stems was weighed by using an analytical balance.

3.6.10. Leaf Dry Weight (g)

The weighed leaves were put into brown envelopes and labeled according to the treatment unit. Then, it was put in the oven for 2×24 hours at a temperature of 70°C. After that, the dried leaves were weighed by using an analytical balance.

3.6.11. Stem Dry Weight (g)

The weighed stems were put into brown envelopes and labeled according to the treatment unit. Then, it was put in the oven for 2×24 hours at a temperature of 70°C. After that, the dried stems were weighed by using an analytical balance.

3.6.12. Root Dry Weight (g)

The weighed roots were put into brown envelopes and labeled according to the treatment unit. Then, it was put in the oven for 2×24 hours at a temperature of 70°C. After that, the dried roots were weighed by using an analytical balance.

3.6.13. Leaf Moisture Content (%)

Leaf moisture content was measured by taking one leaf and placing it in a Petri-dish dish filled with water for ± 2 hours. After that, the leaves were weighed to get the turgid weight. Furthermore, the water content of the leaves was calculated using the following formula.

$$\text{Leaf Moisture Content} = \frac{\text{Leaf fresh weight} - \text{Leaf dry weight}}{\text{Leaf turgit weight} - \text{Leaf dry weight}} \times 100\%$$

3.6.14. Shoot/Root Ratio

Shoot/root ratio obtained by adding the variable 3.5.11 leaf dry weight and 3.5.12 stem dry weight variable and the results of the sum was divided by the 3.5.13 root dry weight variables.

3.6.15. Harvest Index

Harvest index was obtained through the quotient of 3.5.11 Leaf Dry Weight and biomass variables. The weight of biomass was obtained from the sum of the 3.5.11 dry weight of leaves, 3.5.12 dry weight of stems, and 3.5.13 dry weight of roots variables.

CHAPTER 4
RESULTS AND DISCUSSION

4.1. Results

The results of diversity analysis showed that the treatment of planting media composition and transplanting time gave very significant, significant and not significant effect on various plant growth variables. Besides, the treatment of planting media composition had a very significant, significant and no significant effect on the canopy width variable, significant and non-significant effect on the variables of canopy area and leaf greenery and had no significant effect on the variables of plant height and number of leaves. The transplanting time had a very significant, significant and no significant effect on the variables of plant height, leaves number, and canopy width, very significant and not significant effect on the canopy area variable as well as significant and not significant effects on the leaf greenness level variable. The interaction of planting media composition and transplanting time had no significant effect on almost all plant growth variables except for plant height 55 DAS and canopy width 46 DAS which had a significant effect (Table 4.1.1 – Table 4.1.5).

Table 4.1.1. The calculated F value and the various treatment coefficients of planting media composition and transplanting time on Tatsoi height

Plants Height (cm)	F-count			VC (%)
	K	T	K×T	
16 DAS	0,08 nr	20,74 **	0,74 nr	20,54
19 DAS	0,19 nr	32,26 **	1,27 nr	16,85
22 DAS	0,06 nr	17,85 **	0,70 nr	20,07
25 DAS	0,45 nr	7,71 **	0,62 nr	21,14
28 DAS	0,77 nr	5,41 *	0,79 nr	22,19
31 DAS	0,92 nr	3,63 *	0,40 nr	21,09
34 DAS	1,00 nr	3,55 *	0,55 nr	20,14
37 DAS	0,81 nr	3,68 *	0,56 nr	19,56
40 DAS	1,19 nr	2,60 nr	0,49 nr	19,45
43 DAS	1,02 nr	2,63 nr	0,42 nr	18,84
46 DAS	0,89 nr	1,56 nr	0,46 nr	19,52
49 DAS	1,18 nr	1,38 nr	0,44 nr	20,17
52 DAS	0,75 nr	1,02 nr	0,33 nr	22,69
55 DAS	1,05 nr	0,03 nr	2,84 *	32,75
58 DAS	0,22 nr	0,50 nr	0,48 nr	45,12
F Table 5%	3,05	3,44	2,55	
F Table 1%	4,82	5,72	3,76	

Note : VC = Variation Coefficient, ** = Very Real Effect, * = Real Effect, nr = Not real effect

Table 4.1.2. The F-count value and the various treatment coefficients of planting media composition and transplanting time on the number of Tatsoi leaves.

Number of Leaves (Strand)	F-count			VC (%)
	K	T	K×T	
16 DAS	1,44 nr	5,40 *	0,56 nr	8,76
19 DAS	2,16 nr	6,60 **	0,29 nr	8,68
22 DAS	2,82 nr	3,55 *	0,39 nr	8,59
25 DAS	1,76 nr	2,11 nr	0,27 nr	10,84
28 DAS	0,70 nr	0,48 nr	0,26 nr	14,98
31 DAS	2,06 nr	0,32 nr	0,29 nr	19,74
34 DAS	1,21 nr	0,12 nr	0,47 nr	18,49
37 DAS	1,36 nr	0,10 nr	0,47 nr	19,18
40 DAS	1,91 nr	0,01 nr	0,67 nr	19,40
43 DAS	1,91 nr	0,08 nr	1,17 nr	20,04
46 DAS	1,00 nr	0,03 nr	0,91 nr	22,60
49 DAS	1,13 nr	0,18 nr	0,92 nr	21,18
52 DAS	1,17 nr	0,05 nr	0,83 nr	23,98
55 DAS	0,35 nr	0,92 nr	0,84 nr	40,65
58 DAS	0,54 nr	0,85 nr	0,60 nr	44,86
F Table 5%	3,05	3,44	2,55	
F Table 1%	4,82	5,72	3,76	

Note : VC = Variation Coefficient, ** = Very Real Effect, * = Real Effect, nr = Not real effect

Table 4.1.3.The F-count value and the various treatment coefficients of planting media composition and transplanting time on canopy width of Tatsoi

Canopy Width (cm)	F-count			VC (%)
	K	T	K×T	
16 DAS	3,25 *	21,71 **	0,61 nr	8,60
19 DAS	4,09 *	6,00 **	1,04 nr	9,02
22 DAS	6,06 *	0,95 nr	0,63 nr	9,46
25 DAS	4,88 **	0,20 nr	0,60 nr	10,77
28 DAS	3,47 *	2,43 nr	0,33 nr	11,30
31 DAS	2,46 nr	1,66 nr	0,17 nr	13,49
34 DAS	2,40 nr	2,43 nr	0,26 nr	13,42
37 DAS	2,32 nr	1,76 nr	0,38 nr	13,22
40 DAS	4,25 *	3,74 *	1,15 nr	10,41
43 DAS	2,77 nr	5,78 **	1,69 nr	10,61
46 DAS	2,08 nr	8,15 **	3,24 *	8,92
49 DAS	3,12 *	6,47 **	1,93 nr	8,99
52 DAS	1,78 nr	4,00 *	1,54 nr	10,00
55 DAS	0,54 nr	0,50 nr	1,00 nr	29,32
58 DAS	0,12 nr	0,46 nr	0,77 nr	38,55
F Table 5%	3,05	3,44	2,55	
F Table 1%	4,82	5,72	3,76	

Note : VC = Variation Coefficient, ** = Very Real Effect, * = Real Effect, nr = Not real effect

Tabel 4.1.4. The F-count value and the various treatment coefficients of planting media composition and transplanting time on Tatsoi canopy area.

Canopy Area (cm^2)	F-count			VC (%)
	K	T	K×T	
16 DAS	1,37 nr	19,73 **	0,64 nr	23,41
19 DAS	1,39 nr	2,25 nr	0,38 nr	26,28
22 DAS	2,56 nr	0,07 nr	0,25 nr	19,95
25 DAS	2,34 nr	0,21 nr	0,07 nr	28,31
29 DAS	3,27 *	0,30 nr	0,17 nr	25,07
31 DAS	2,17 nr	0,62 nr	0,11 nr	28,01
34 DAS	2,29 nr	0,54 nr	0,65 nr	24,64
37 DAS	3,59 *	1,01 nr	0,62 nr	24,45
40 DAS	2,70 nr	2,78 nr	0,86 nr	23,17
43 DAS	2,84 nr	1,91 nr	1,83 nr	21,48
46 DAS	2,54 nr	1,82 nr	1,98 nr	21,18
49 DAS	3,43 *	1,05 nr	1,20 nr	21,18
52 DAS	0,99 nr	1,35 nr	0,63 nr	27,18
55 DAS	0,31 nr	0,08 nr	0,42 nr	50,91
58 DAS	0,62 nr	0,28 nr	0,71 nr	51,62
F Table 5%	3,05	3,44	2,55	
F Table 1%	4,82	5,72	3,76	

Note : VC = Variation Coefficient, ** = Very Real Effect, * = Real Effect, nr = Not real effect

Table 4.1.5.The F-count value and the various treatment coefficients of planting media composition and transplanting time on leaf greenness level of Tatsoi

Leaf Greenness Level	F-count			VC (%)
	K	T	K×T	
17 DAS	0,60 nr	4,31 *	1,81 nr	4,59
27 DAS	3,69 *	0,74 nr	2,09 nr	5,51
38 DAS	2,17 nr	2,81 nr	0,41 nr	6,30
47 DAS	1,13 nr	0,58 nr	0,89 nr	18,62
F Table 5%	3,05	3,44	2,55	
F Table 1%	4,82	5,72	3,76	

Note : VC = Variation Coefficient, ** = Very Real Effect, * = Real Effect, nr = Not real effect

The results of diversity analysis showed that the treatment of planting media composition had no significant effect or not real effect on almost all harvest variables, except for chlorophyll a and leaf dry weight which had a significant effect or real effect and on harvest index variables which had a very significant effect or very real effect. Besides, analysis of variance results showed that the transplanting time had no significant effect or no real effect on almost all harvest variables, except for the variables of canopy width, total chlorophyll, chlorophyll a, and harvest index which had a significant effect or real effect. The interaction between the combination treatment of planting media composition and transplanting time had no significant effect or no real effect on almost all harvest variables except for the harvest index variable which had a significant effect or real effect (Table 4.2).

Table 4.2.The F-count value and the various treatment coefficients of planting media composition and transplanting time on Tatsoi harvesting variables

No.	Variables	F-count			VC
		K	T	K×T	(%)
1.	Plant height (cm)	0,16 nr	1,21 nr	0,35 nr	27,35
2.	Number of Leaves (strands)	1,75 nr	0,04 nr	0,52 nr	23,73
3.	Canopy Width (cm)	2,81 nr	4,56 *	1,03 nr	16,14
4.	Canopy Area (cm^2)	2,38 nr	1,08 nr	0,63 nr	32,23
5.	Leaf Greenness Level	1,72 nr	0,98 nr	1,15 nr	3,76
6.	Chlorophyll Analysis (mg/L)				
	Total Chlorophyll	2,69 nr	4,22 *	0,37 nr	22,35
	Chlorophyll A	4,07 *	4,61 *	0,50 nr	23,56
	Chlorophyll B	0,77 nr	2,48 nr	0,82 nr	36,84
7.	Leaf Fresh Weight (g)	4,68 *	1,40 nr	0,41 nr	36,56
8.	Stem Fresh Weight (g)	2,10 nr	0,29 nr	0,27 nr	36,12
9.	Root Fresh Weight (g)	2,30 nr	1,15 nr	0,79 nr	58,76
10.	Leaf Dry Weight (g)	3,73 *	2,38 nr	0,44 nr	33,72
11.	Stem Dry Weight (g)	0,16 nr	0,51 nr	0,52 nr	34,73
12.	Root Dry Weight (g)	2,27 nr	1,14 nr	0,83 nr	68,25
13.	Leaf Moisture Content (%)	1,42 nr	0,07 nr	0,49 nr	4,99
14.	Shoot/root ratio	1,51 nr	0,27 nr	0,49 nr	56,01
15.	Harvest Index	17,31 **	4,48 *	3,04 *	7,09
	F Table 5%	3,05	3,44	2,55	
	F Table 1%	4,82	5,72	3,76	

Note : VC = Variation Coefficient, ** = Very Real Effect, * = Real Effect, nr = Not real effect

4.1.1. Plant Height (cm)

The results of variance analysis showed that the composition of the planting media had no significant effect or no real effect on the plant height variable. Besides, the results of variance analysis showed that the transplanting time had a very significant effect or very real effect on 16 DAS, 19 DAS, 22 DAS, and 25 DAS, also had significant effect or real effect on 28 DAS, 31 DAS, 34 DAS, and 37 DAS. Moreover, there was no significant effect or no real effect on

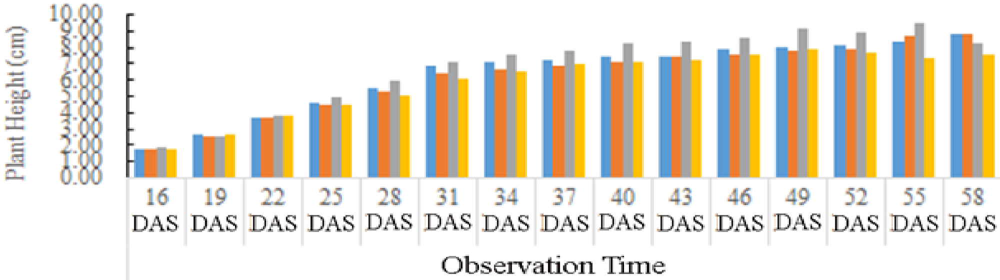
40 DAS, 43 DAS, 46 DAS, 49 DAS, 52 DAS, 55 DAS, 58 DAS (Table 4.1.1), and at harvest on plant height variables (Table 4.2).

Table 4.3. The LSD test results of planting media composition effect and transplanting time effect on Tatsoi height

Treatments	Observation time							
	16 DAS		19 DAS		22 DAS		25 DAS	
Planting Media Composition								
K_0	1,76	a	2,69	a	3,72	a	4,63	a
K_1	1,79	a	2,57	a	3,66	a	4,54	a
K_2	1,83	a	2,54	a	3,80	a	4,98	a
K_3	1,76	a	2,62	a	3,78	a	4,49	a
LSD 0,05	0,36		0,43		0,73		0,96	
Planting Time								
T_1	2,23	a	3,16	a	4,48	a	5,29	a
T_2	1,85	b	2,86	a	4,03	a	4,92	a
T_3	1,28	c	1,79	b	2,72	b	3,78	b
LSD 0,05	0,31		0,37		0,64		0,83	
Treatments	Observation time							
	28 DAS		31 DAS		34 DAS		37 DAS	
Planting Media Composition								
K_0	5,48	a	6,86	a	7,09	a	7,2	a
K_1	5,32	a	6,43	a	6,67	a	6,84	a
K_2	5,93	a	7,11	a	7,56	a	7,8	a
K_3	5,09	a	6,11	a	6,51	a	6,97	a
LSD 0,05	1,18		1,37		1,37		1,38	
Planting Time								
T_1	6,17	a	7,17	a	7,47	a	7,76	a
T_2	5,64	a	6,97	a	7,31	a	7,53	a
T_3	4,57	b	5,75	b	6,08	b	6,31	b
LSD 0,05	1,03		1,18		1,19		1,19`	

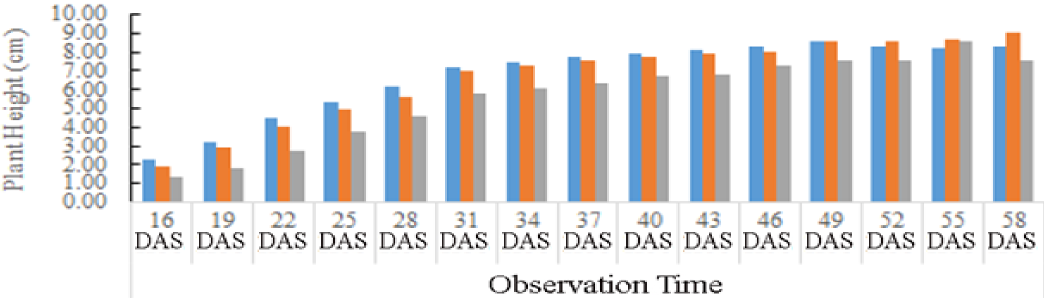
Numbers followed by the same letter in the same column were not significantly different in the 5% HSD test.

The results of LSD test showed that the planting media composition was not significantly different. The highest plant height was mostly obtained in K_2 and T_1 treatments, but the results of LSD test showed that T_1 and T_2 treatments were not significantly different while the lowest plant height was mostly obtained in K_3 and T_3 treatments (Table 4.3). The interaction of planting media composition and transplanting time had no significant effect on plant height variables, except at the age of 55 DAS which had a significant effect. The increase in plant height could be seen in Figure 4.1 and Figure 4.2. In Figure 4.1 and Figure 4.2, there was a decrease in height in 58 DAS due to the previous harvesting of several plants that had met the harvest criteria. Therefore, the reduced number of plants observed had an effect on the average plant height



	16 DAS	19 DAS	22 DAS	25 DAS	28 DAS	31 DAS	34 DAS	37 DAS	40 DAS	43 DAS	46 DAS	49 DAS	52 DAS	55 DAS	58 DAS
K0	1.7	2.6	3.7	4.6	5.4	6.8	7.0	7.2	7.4	7.4	7.8	8.0	8.1	8.3	8.7
K1	1.7	2.5	3.6	4.5	5.3	6.4	6.6	6.8	7.1	7.4	7.5	7.8	7.9	8.7	8.7
K2	1.8	2.5	3.8	4.9	5.9	7.1	7.5	7.8	8.2	8.3	8.5	9.1	8.9	9.5	8.2
K3	1.7	2.6	3.7	4.4	5.0	6.1	6.5	6.9	7.0	7.2	7.5	7.9	7.6	7.3	7.5

Figure 4.1. Planting media composition effects on Tatsoi height



	16 DAS	19 DAS	22 DAS	25 DAS	28 DAS	31 DAS	34 DAS	37 DAS	40 DAS	43 DAS	46 DAS	49 DAS	52 DAS	55 DAS	58 DAS
T1	2.2	3.1	4.4	5.2	6.1	7.1	7.4	7.7	7.9	8.1	8.3	8.5	8.3	8.1	8.3
T2	1.8	2.8	4.0	4.9	5.6	6.9	7.3	7.5	7.7	7.9	8.0	8.5	8.5	8.6	9.1
T3	1.2	1.7	2.7	3.7	4.5	5.7	6.0	6.3	6.6	6.8	7.2	7.5	7.5	8.6	7.5

Figure 4.2. Transplanting time effects on Tatsoi

At harvest the highest plant height was obtained in treatment K_2 with the mean plant height was 8.95 cm (Figure 4.3), treatment T_1 with mean plant height was 9.18 cm (Figure 4.4), and the combination treatment K_1T_2 with mean plant height was 10.17 cm (Figure 4.5). Meanwhile, the lowest plant height was obtained in treatment K_3 with the mean plant height was 8.24 cm (Figure 4.3), treatment T_3 with the mean plant height was 7.77 cm (Figure 4.4), and the treatment combination K_3T_3 with the mean height was 7.22 cm (Figure 4.5).

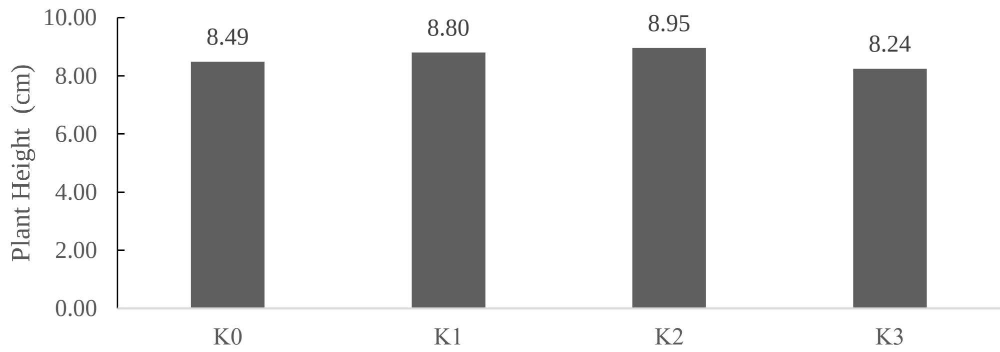


Figure 4.3. Planting media composition effect on Tatsoi height at harvest

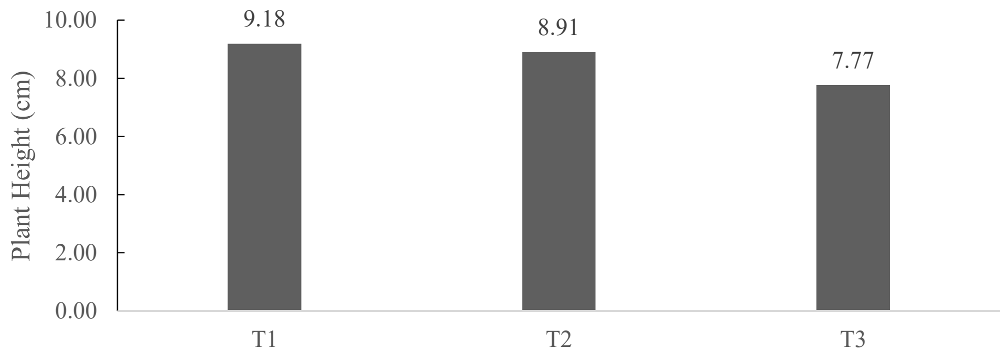


Figure 4.4. The effect of planting media composition on Tatsoi height at harvest

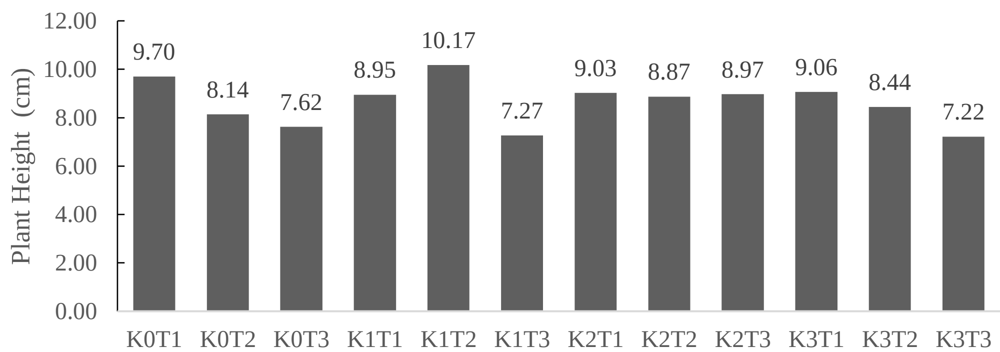


Figure 4.5. Tatsoi height at harvest in various treatment combinations, planting media composition and transplanting time

4.1.2. Number of Leaves (strands)

The results of diversity analysis showed that the planting media composition had no significant effect on the number of leaves. Besides, the results of variance analysis showed that the transplanting time had a very significant effect or very real effect on 19 DAS, had significant effect on 16 DAS and 22

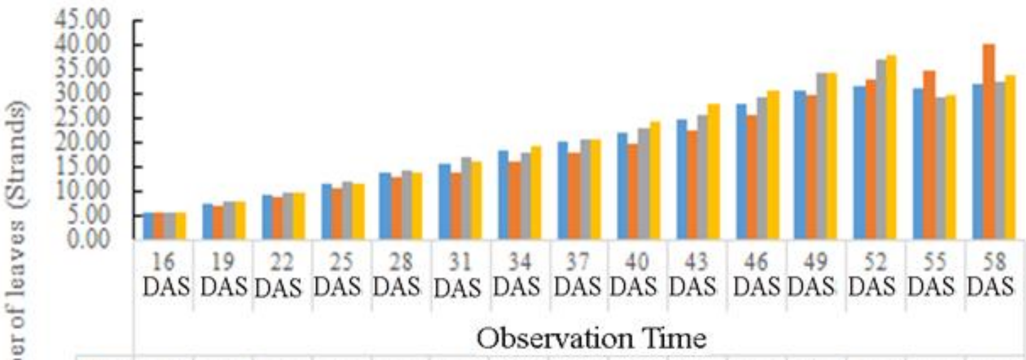
DAS and had no significant effect or no real effect on 25 DAS (Table 4.1.2) until the harvest time on the number of leaves variable (Table 4.2).

Table 4.4. The LSD test results of planting media composition effect and transplanting time effect on the number of Tatsoi

Treatments	Observation time					
	16 DAS		19 DAS		22 DAS	
Planting Media Composition						
K_0	5,37	a	7,26	ab	9,11	ab
K_1	5,33	a	6,96	b	8,63	b
K_2	5,67	a	7,59	a	9,59	a
K_3	5,70	a	7,63	a	9,52	a
LSD 0,05	0,47		0,62		0,77	
Planting Time						
T_1	5,58	a	7,5	a	9,22	ab
T_2	5,81	a	7,75	a	9,64	a
T_3	5,17	b	6,83	b	8,78	b
LSD 0,05	0,41		0,54		0,70	

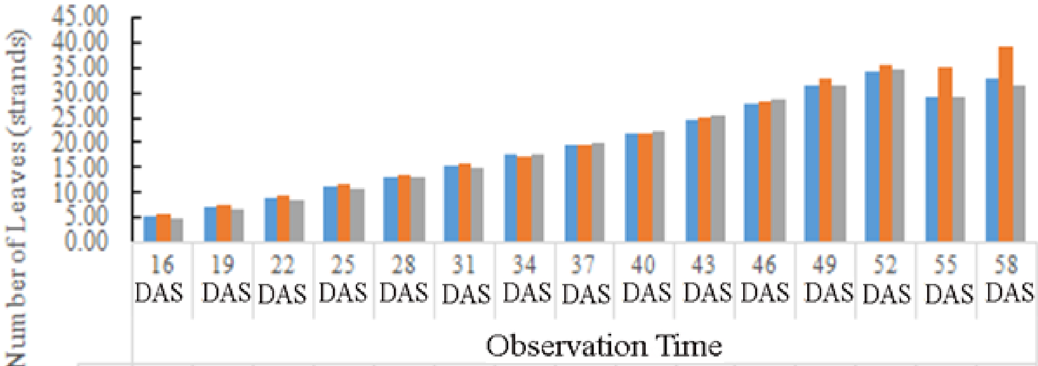
Numbers followed by the same letter in the same column were not significantly different in the 5% HSD test.

At 16 DAS, the highest number of leaves was obtained in K_3 and T_2 treatments, while the lowest number of leaves was obtained in K_1 and T_3 treatments. The results of LSD test at 16 DAS showed that the treatment of planting media composition was not significantly different and the T_2 and T_1 treatments were not significantly different. Besides, at 19 DAS, the highest number of leaves was obtained in K_3 and T_2 treatments, while the lowest number of leaves was obtained in K_1 and T_3 treatments. The results of LSD test at 19 DAS showed that K_3 and K_2 treatments and T_2 and T_1 treatments were not significantly different. Moreover, at 22 DAS, the highest number of leaves was obtained in K_2 and T_2 treatments but the lowest number of leaves was obtained in K_1 and T_3 treatments. The results of the LSD test at 22 DAS showed that the K2 and K3 treatments were not significantly different (Table 4.4). Therefore, the interaction of planting media composition and transplanting time had no significant effect on the number of leaves. Furthermore, the increase in the number of leaves could be seen in Figure 4.6 and figure 4.7, where there was a decrease in the number of leaves at 55 DAS and 58 DAS due to bacterial wilt disease which caused the stems and growing points to rot so that the leaves on some plants withered and fell.



	16 DAS	19 DAS	22 DAS	25 DAS	28 DAS	31 DAS	34 DAS	37 DAS	40 DAS	43 DAS	46 DAS	49 DAS	52 DAS	55 DAS	58 DAS
K0	5.37	7.26	9.11	11.3	13.5	15.5	18.1	20.1	21.8	24.6	28.1	30.6	31.6	31.2	32.3
K1	5.33	6.96	8.63	10.5	12.8	13.6	16.1	17.7	19.6	22.5	25.8	29.7	33.2	34.9	40.4
K2	5.67	7.59	9.59	11.7	14.1	17.0	18.0	20.8	22.8	25.9	29.3	34.3	37.0	29.2	32.6
K3	5.70	7.63	9.52	11.7	13.7	16.3	19.0	20.7	24.3	28.0	30.8	34.3	38.0	29.9	33.8

Figure 4.6. The effect of planting media composition on the number of Tatsoi leaves



	16 DAS	19 DAS	22 DAS	25 DAS	28 DAS	31 DAS	34 DAS	37 DAS	40 DAS	43 DAS	46 DAS	49 DAS	52 DAS	55 DAS	58 DAS
T1	5.58	7.50	9.22	11.3	13.5	15.7	18.0	19.8	22.0	24.8	28.1	31.8	34.5	29.2	33.2
T2	5.81	7.75	9.64	11.8	14.0	16.0	17.4	19.5	22.1	25.4	28.6	33.1	35.6	35.4	39.5
T3	5.17	6.83	8.78	10.8	13.1	15.0	18.0	20.2	22.2	25.6	28.8	31.6	34.7	29.3	31.6

Figure 4.7. The effect of transplanting time on the number of Tatsoi leaves

At the harvest time, the highest number of leaves was obtained in K_2 treatment with an average number of leaves was 42.91 (Figure 4.8), T_3 with an average number of leaves was 39.78 (Figure 4.9), treatment combination of K_3T_2 with the average number was 46.11 (Figure 4.10). Meanwhile, the lowest number of leaves was obtained in K_0 treatment with the average number of leaves was 33.46 (Figure 4.8), T_1 treatment with the average number of leaves was 38.85 (Figure 4.9), and treatment combination of K_0T_2 with the average number of eaves was 31.39 (Figure 4.10).

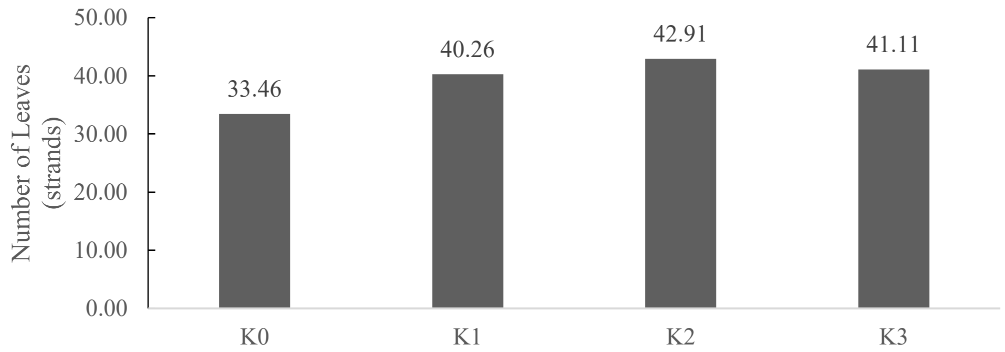


Figure 4.8. The effect of planting media composition on the number of Tatsoi leaves at harvest

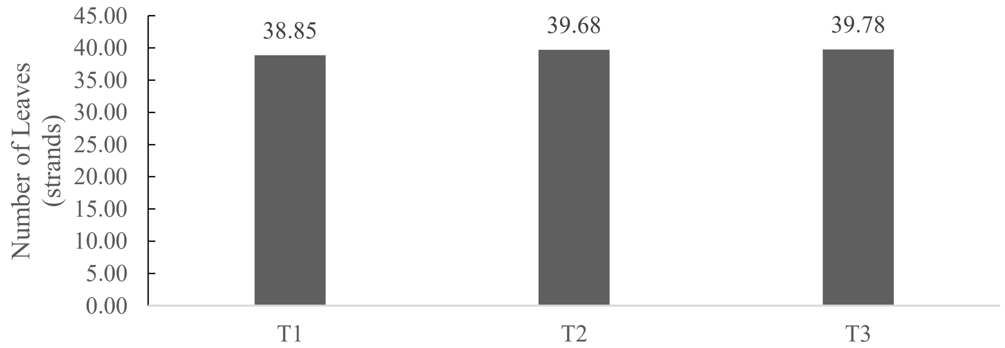


Figure 4.9. The effect of transplanting time on the number of Tatsoi leaves at harvest

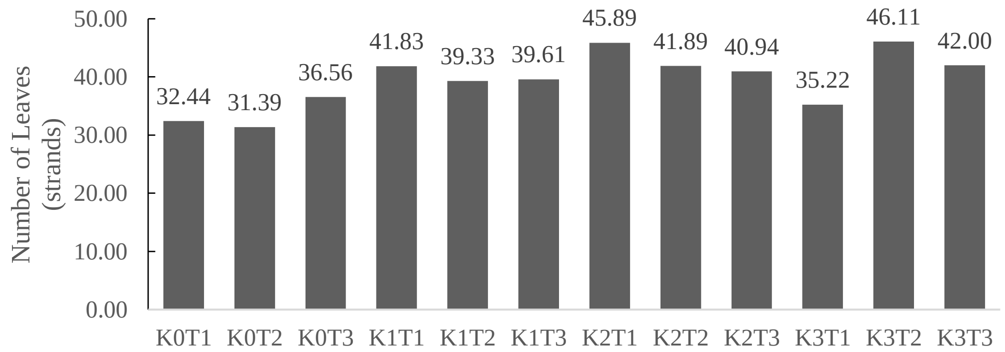


Figure 4.10. The number of Tatsoi leaves at harvest in various treatment combination of planting media composition and transplanting time

4.1.3. Canopy Width (cm)

The result of variant analysis showed that the planting media composition had a very significant effect or very real effect on 25 DAS, significant effect or real effect on 16 DAS, 19 DAS, 22 DAS, 28 DAS, 40 DAS and 49 DAS and had no significant effect or no real effect on 31 DAS, 34 DAS, 37 DAS, 43 DAS, 46 DAS, 52 DAS, 55DAS, 58 DAS (Table 4.1.3), and at harvest on the variable of canopy width (Table 4.2). The results of variance analysis showed that the transplanting time had a very significant effect on 16 DAS, 19 DAS, 43 DAS, 46 DAS, and 49 DAS, had significant effect or real effect on 40 DAS, 52 DAS (Table 4.1.3), and at harvest (Table 4.2) and had no significant effect on 22 DAS to 37 DAS, 55 DAS and 58 DAS on the canopy width variable (Table 4.1.3).

Table 4.5. LSD test results of planting media composition effect and transplanting time effect on canopy width of Tatsoi

Treatments	Observation time							
	16 DAS		19 DAS		22 DAS		25 DAS	
Planting Media Composition								
K_0	4,57	bc	6,31	bc	7,92	bc	9,96	a
K_1	4,48	c	6,13	c	7,32	c	8,82	b
K_2	4,98	a	6,78	ab	8,68	a	10,55	a
K_3	4,89	ab	6,98	a	8,58	ab	10,44	a
LSD 0,05	0,40		0,58		0,75		1,05	
Transplanting Time								
T_1	4,99	a	6,63	a	7,91	a	9,84	a
T_2	5,10	a	6,92	a	8,34	a	9,90	a
T_3	4,10	b	6,09	b	8,12	a	10,10	a
LSD 0,05	0,34		0,50		0,65		0,91	
Treatments	Observation time							
	28 DAS		40 DAS		43 DAS		46 DAS	
Planting Media Composition								
K_0	11,18	ab	16,42	b	17,08	ab	17,32	ab
K_1	10,49	b	16,10	b	16,51	b	17,11	b
K_2	12,29	a	18,82	a	18,90	a	18,81	a
K_3	11,96	a	17,56	ab	17,87	ab	17,64	ab
LSD 0,05	1,27		1,75		1,82		1,55	
Transplanting Time								
T_1	10,96	b	16,38	b	16,67	b	16,53	b
T_2	11,36	ab	16,97	ab	17,03	b	17,53	b
T_3	12,11	a	18,33	a	19,07	a	19,11	a
LSD 0,05	1,1		1,52		1,58		1,34	

Treatments	Observation time			
	49 DAS		52 DAS	
Planting Media Composition				
K_0	17,15	b	17,34	a

K_1	17,46	b	17,35	a
K_2	19,30	a	19,02	a
K_3	18,15	ab	18,13	a
LSD 0,05	1,58		1,76	
Transplanting time				
T_1	17,21	b	17,25	b
T_2	17,46	b	17,48	b
T_3	19,38	a	19,15	a
LSD 0,05	1,37		1,52	

Numbers followed by the same letter in the same column were not significantly different in the 5% HSD test.

The highest canopy width was mostly obtained in the K_2 and T_3 treatments. Meanwhile, the lowest canopy width was mostly obtained in the K_1 and T_1 treatments (Table 4.5). The interaction of planting media composition and transplanting time had no significant effect on the canopy width variable except for the plant age 46 DAS which had a significant effect. The increase in canopy width could be seen in Figure 4.11 and Figure 4.12, where there was a decrease in canopy width at 55 DAS and 58 DAS due to bacterial wilt disease which caused the plants to wilt so that canopy width was reduced.

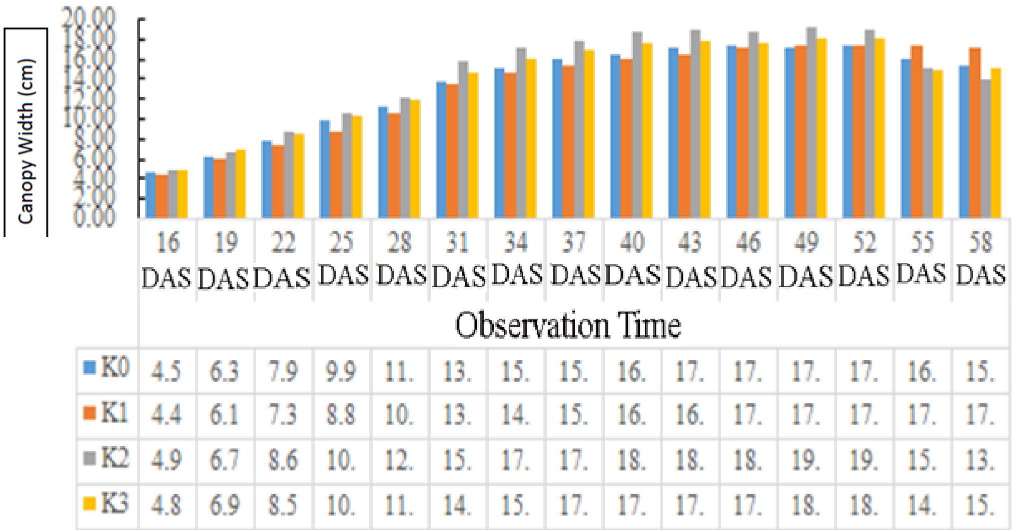


Figure 4.11. The effects of planting media composition on the canopy width of Tatsoi

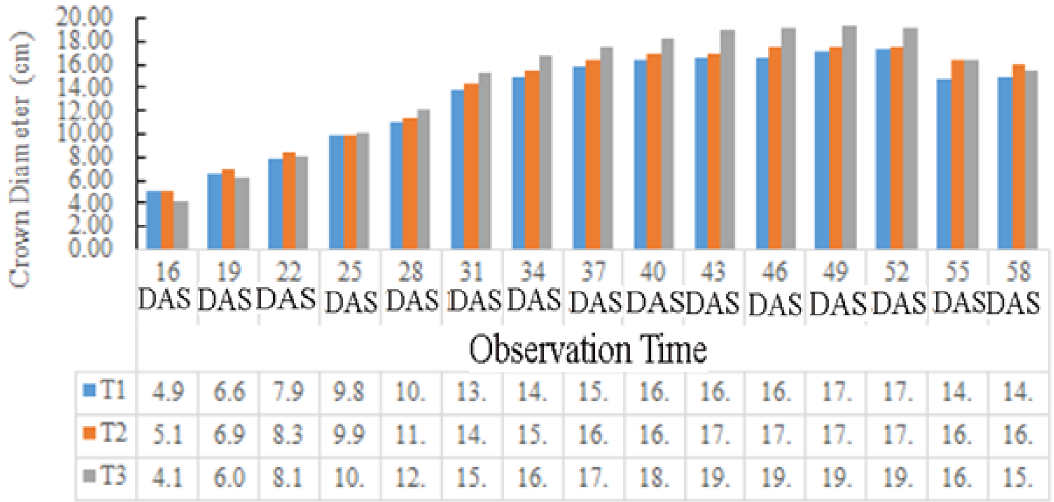


Figure 4.12. The effects of transplanting media on the canopy width of Tatsoi

At harvest, the highest canopy width was obtained in K_2 treatment with the average canopy width was 20.10 cm, T_3 treatment with the average canopy width was 19.99 cm (Table 4.6), and treatment combination of K_2T_3 with the average canopy width was 22.96 cm (Figure 4.13). Meanwhile, the lowest canopy width was obtained in K_0 treatment with the average number of canopy width was 16.30 cm, T_1 with an average canopy width was 16.65 cm (Table 4.6), and treatment combination of K_0T_1 with the average diameter was 14.03 cm (Figure 4.13). The results of LSD test showed that T_1 treatment was not significantly different from T_2 treatment (Table 4.6).

Table 4.6. LSD test results of planting media composition effect and transplanting time effect on canopy width of Tatsoi at harvest

Planting Media Composition	Canopy Width (cm)	
K_0	16,30	b
K_1	17,27	ab
K_2	20,10	a
K_3	18,16	ab
LSD 0,05	2,83	
Transplanting time	Canopy Width (cm)	
T_1	16,65	b
T_2	17,23	b
T_3	19,99	a
LSD 0,05	2,45	

Numbers followed by the same letter in the same column were not significantly different in the 5% HSD test.

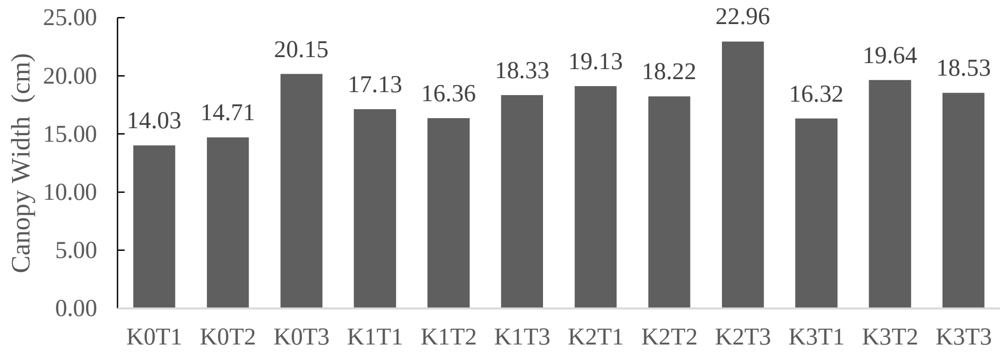


Figure 4.13. Canopy Width of Tatsoi at harvest in various treatment combinations, planting media composition and transplanting time

4.1.4. Canopy Area (cm^2)

The results of the diversity analysis showed that the treatment of planting media composition had no significant effect on the canopy area variables, except for 28 DAS, 37 DAS, and 49 DAS which had a significant effect (Table 4.1.4 and Table 4.2). The results of analysis of variance showed that transplanting time had no significant effect on canopy area variables, except 16 DAS which had a very significant effect or very real effect (Table 4.1.4 and Table 4.2).

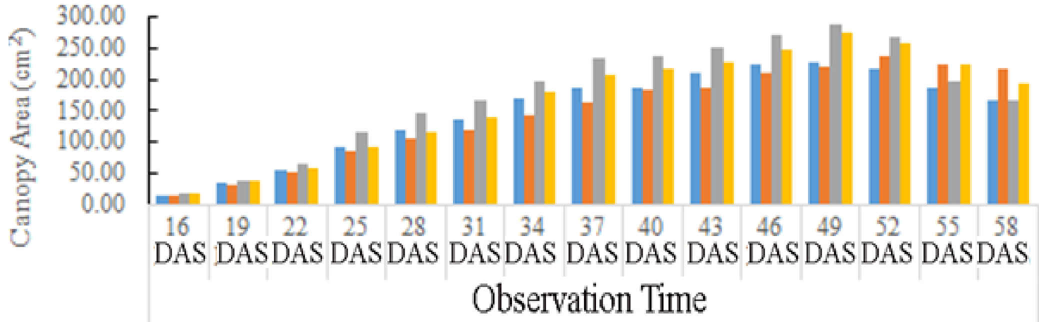
Table 4.7. The LSD result test of planting media composition effect and transplanting time effect on the canopy area of Tatsoi

Treatments	Observation time							
	16 DAS		29 DAS		37 DAS		49 DAS	
Planting Media Composition								
K_0	16,36	a	119,21	ab	187,45	ab	228,59	bc
K_1	15,12	a	104,29	b	161,60	b	221,56	c
K_2	18,34	a	147,89	a	233,56	a	287,71	a
K_3	18,22	a	116,67	b	207,38	ab	275,33	ab
LSD 0,05	3,89		29,90		47,21		52,46	
Transplanting time								
T_1	18,42	a	116,69	a	185,1	a	240,8	a
T_2	21,27	a	123,22	a	194,7	a	247,89	a
T_3	11,35	b	126,13	a	212,69	a	271,19	a
LSD 0,05	3,37		25,90		40,89		45,43	

Numbers followed by the same letter in the same column were not significantly different in the 5% HSD test.

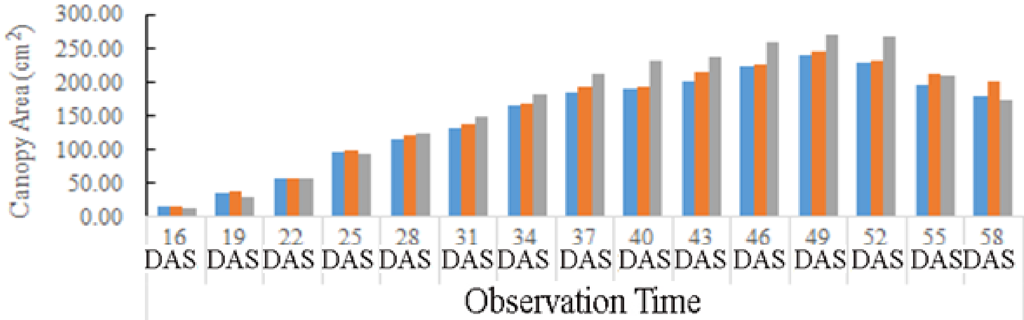
The results of the LSD test showed that planting media composition treatment was not significantly different to the variables of canopy area at 28

DAS, 37 DAS, and 49 DAS. The highest canopy area was mostly obtained in K_2 and T_3 treatments. Meanwhile, the lowest canopy width was mostly obtained in K_1 and T_1 treatments (Table 4.7). The interaction of planting media composition and transplanting time had no significant effect on the canopy area variable. The increase in canopy area could be seen in Figure 4.14 and Figure 4.15, where there was a decrease in the canopy area at 52 DAS, 55 DAS, and 58 DAS due to bacterial wilt disease which caused plants to wither so that the canopy area was reduced.



	16 DAS	19 DAS	22 DAS	25 DAS	28 DAS	31 DAS	34 DAS	37 DAS	40 DAS	43 DAS	46 DAS	49 DAS	52 DAS	55 DAS	58 DAS
K0	15.	33.	54.	92.	119	135	170	187	188	211	224	229	217	185	165
K1	13.	30.	52.	84.	104	120	144	161	181	188	209	222	236	224	218
K2	17.	38.	66.	117	147	166	195	233	238	251	270	288	267	196	166
K3	16.	36.	58.	93.	116	140	179	207	217	226	247	275	257	224	192

Figure 4.14. The effect of planting media composition on the canopy area of Tatsoi



	16 DAS	19 DAS	22 DAS	25 DAS	28 DAS	31 DAS	34 DAS	37 DAS	40 DAS	43 DAS	46 DAS	49 DAS	52 DAS	55 DAS	58 DAS
T1	15.	35.	57.	96.	117	132	165	185	192	202	226	241	229	197	180
T2	16.	38.	58.	100	123	139	169	195	194	216	226	248	234	214	202
T3	15.	30.	57.	93.	126	150	182	213	233	239	260	271	270	210	174

Figure 4.15. The effect of transplanting time on the canopy area of Tatsoi

At harvest time, the highest canopy area was obtained in C_2 treatment with the average canopy area was 280.61 cm^2 (Figure 4.16), T_3 treatment with the average canopy area was 262.90 cm^2 (Figure 4.17), and the combination of C_2T_3 treatments with the average canopy area was 292.06 cm^2 (Figure 4.18). Meanwhile, the lowest canopy area was obtained in C_0 treatment with the average canopy area was 189.76 cm^2 (Figure 4.16), T_1 treatment with the average canopy area was 223.23 cm^2 (Figure 4.17), and the combination of C_0T_1 treatments with the average canopy area was 148.74 cm^2 (Figure 4.18).

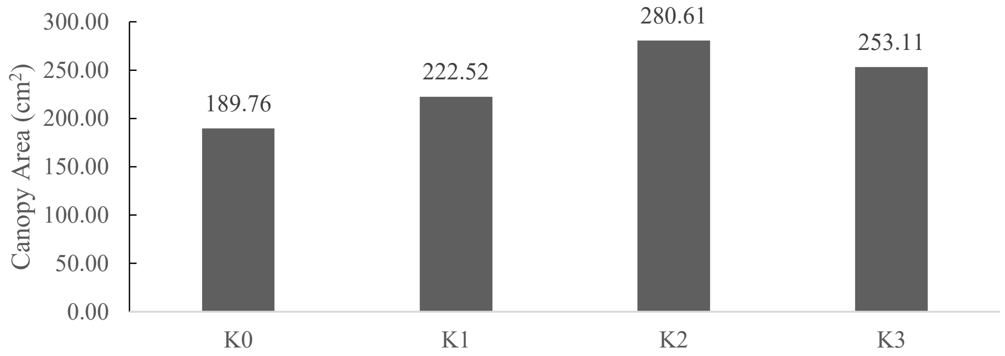


Figure 4.16. The effect of planting media composition on the canopy area of Tatsoi

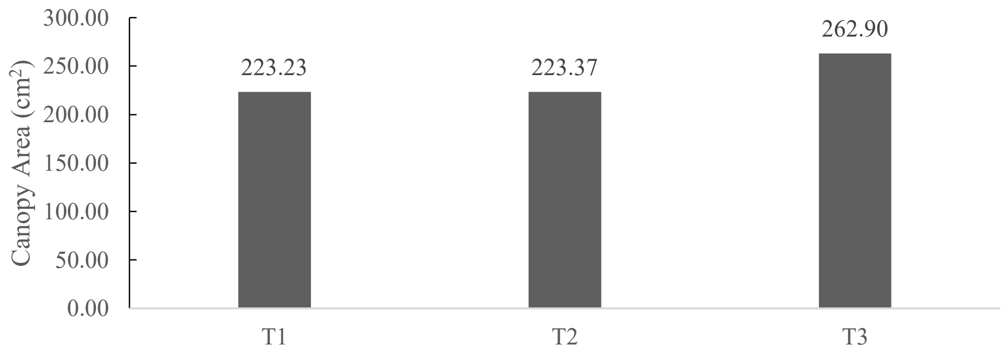


Figure 4.17. The effect of transplanting time on canopy area of Tatsoi

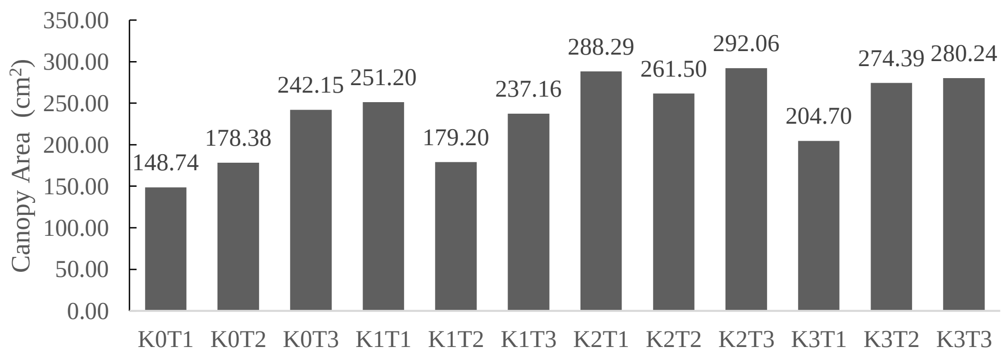


Figure 4.18. The canopy area of Tatsoi at harvest in various treatment combinations, planting media composition and transplanting time

4.1.5. Leaf Greenness Level

The results of diversity analysis showed that the planting media composition treatments had no significant effect on the leaf greenness level, except for 27 DAS which had a significant effect (Table 4.1.5 and Table 4.2). The results of analysis of variance showed that the transplanting time treatment had no significant effect on the leaf greenness level, except for 17 DAS which had a significant effect (Table 4.1.5 and Table 4.2)

Table 4.8. The LSD test results of planting media composition effect and transplanting time effect on the leaf greenness level of Tatsoi

Treatments	Observation time			
	17 DAS		27 DAS	
Planting Media Composition				
K_0	35,04	a	36,09	ab
K_1	34,14	a	35,37	b
K_2	34,23	a	34,93	b
K_3	34,57	a	37,82	a
LSD 0,05	1,55		1,94	
Transplanting time				
T_1	35,59	a	36,04	a
T_2	33,96	b	36,54	a
T_3	33,93	b	35,56	a
LSD 0,05	1,34		1,68	

The numbers followed by the same letter in the same column were not significantly different in the 5% HSD test.

LSD test results showed that the treatment of planting media composition was not significantly different to the leaf greenness variable at 17 DAS and transplanting time was not significantly different to the leaf greenness level variable at 27 DAS. At 17 DAS, the highest level of leaf greenness was obtained in K_0 and T_1 treatment but the lowest level of leaf greenness was obtained in K_1 and T_3. At 27 DAS, the highest level of leaf greenness was obtained in K_3 and T_2 treatment, while the lowest level of leaf greenness was obtained in K_2 and T_3 treatment. The results of LSD test at 17 DAS were T_3 and T_2 treatments were not significantly different. Besides, LSD test results at 27 DAS showed that K_2 and K_1 treatments were not significantly different (Table 4.8). Moreover, the interaction of planting media composition and transplanting time had no significant effect on the leaf greenery level. The development of the leaf greenness level could be seen in Figure 4.19 and Figure 4.20.

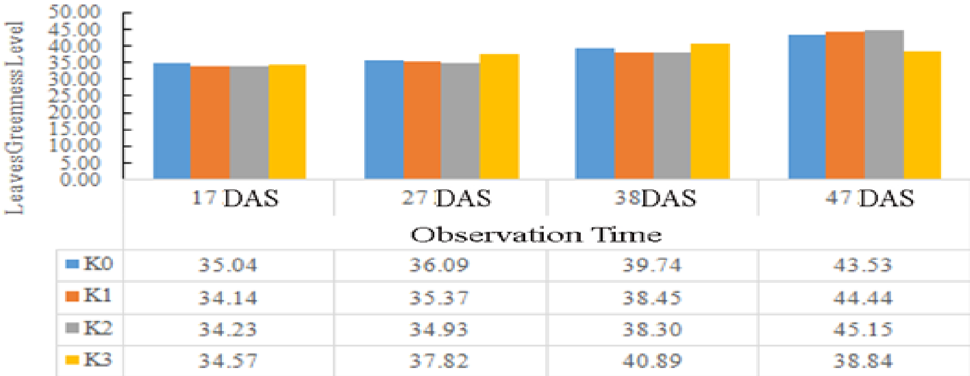


Figure 4.19. The effects of planting media composition on the leaf greenness level of Tatsoi

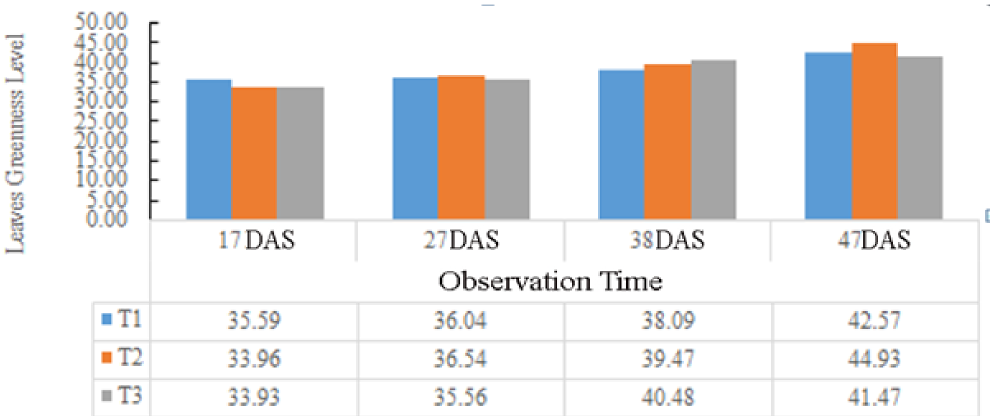


Figure 4.20. The effects of transplanting time on the leaf greenness level of Tatsoi

At harvest time, the highest level of the leaf greenness was in K_3 with the average of the leaf greenness level was 47.09 (Figure 4.21), T_2 treatment with the average number of the leaf greenness level was 46.48 (Figure 4.22), and the combination of K_0T_2 treatments with the average number of the leaf greenness level was 47.40 (Figure4.23). Meanwhile, the lowest level of the leaf greenness was in K_0 treatment with the average number of the leaf greenness level was 45.32 (Figure 4.21), T_3 treatment with the average number of the leaf greenness level was 45.50 (Figure 4.22), and the combination of K_0T_3 treatments with the average number of the leaf greenness level was 43.96 (Figure 4.23).

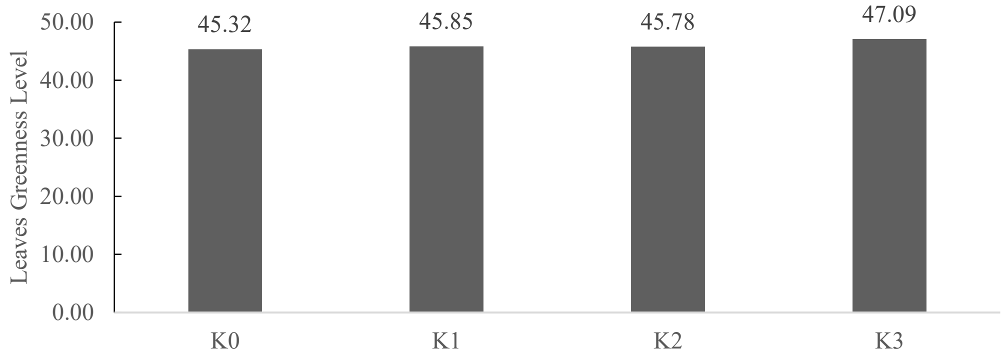


Figure 4.21. The effects of planting media composition on the leaf greenness level of Tatsoi at harvest

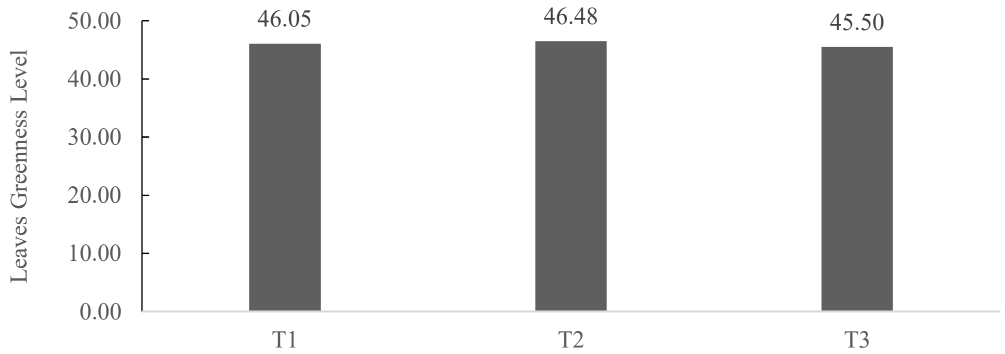


Figure 4.22. The effects of transplanting time on the leaf greenness level of Tatsoi at harvest

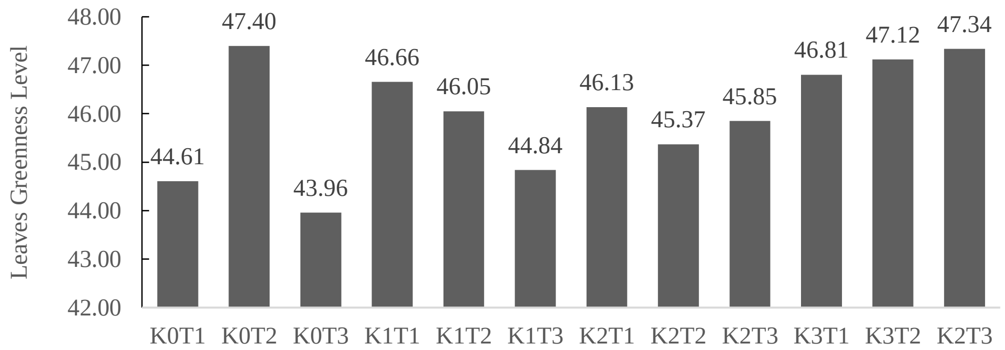


Figure 4.23. The leaves greenness levels of Tatsoi at harvest in various combinations of treatments, planting media composition and transplanting media

4.1.6. Chlorophyll Analysis (mg/L)

The results of LSD test showed that the treatment of planting media composition was not significantly different to the total of chlorophyll analysis. The highest total chlorophyll was obtained in K_3 treatment with the average number of total chlorophyll was 12.85 mg/L, T_2 treatment with the average number of total chlorophyll was 12,99 mg/L (Table 4.9), and the combination of K_3T_2 treatments with the average number of total chlorophyll was 14.49 mg/L (Figure 4.24). Meanwhile, the lowest total chlorophyll was in K_1 with the average number of total chlorophyll was 9.59 mg/L, T_3 treatment with the average number of total chlorophyll was 10,15 mg/L (Table 4.9), and the combination of K_1T_3 treatment with the average number of total chlorophyll was 7.96 mg/L (Figure 4.24). LSD results showed that T_3 treatment was not significantly different from T_1 treatment (Table 4.9).

Beside, the highest chlorophyll a was obtained in K_3 treatment with the average number of chlorophyll a was 11.02 mg/L, T_2 treatment with the average number of chlorophyll a was 11.07 mg/L (Table 4.9), and the combination of K_3T_2 treatments with the average number of chlorophyll a was 14 mg/L (Figure 4.25), but the lowest chlorophyll a was in K_1 treatment with the average number of chlorophyll a was 7,58 mg/L, T_3 and T_2 treatments with the average number of chlorophyll a was 8.68 mg/L (Table 4.9), and the combination of K_1T_3 treatments with the average number of chlorophyll a was 6,45 mg/L (Figure 4.25). LSD test results presented that K_3 treatment was not significantly different from K_2 treatment (Table 4.9).

Table 4.9. LSD test results of planting media composition effect and transplanting time effect on the content of total chlorophyll and chlorophyll b of Tatsoi at harvest

Planting media composition	Total Chlorophyll (mg/L)		Chlorophyll A (mg/L)	
K_0	10,94	a	9,05	ab
K_1	9,59	a	7,58	b
K_2	11,80	a	10,25	a
K_3	12,85	a	11,02	a
LSD 0,05	2,47		2,18	
Transplanting time	Total Chlorophyll (mg/L)		Chlorophyll A (mg/L)	
T_1	10,74	b	8,68	b
T_2	12,99	a	11,07	a

T_3	10,15	b	8,68	b
LSD 0,05	2,14		1,89	

The numbers followed by the same letter in the same column were not significantly different in the 5% HSD test.

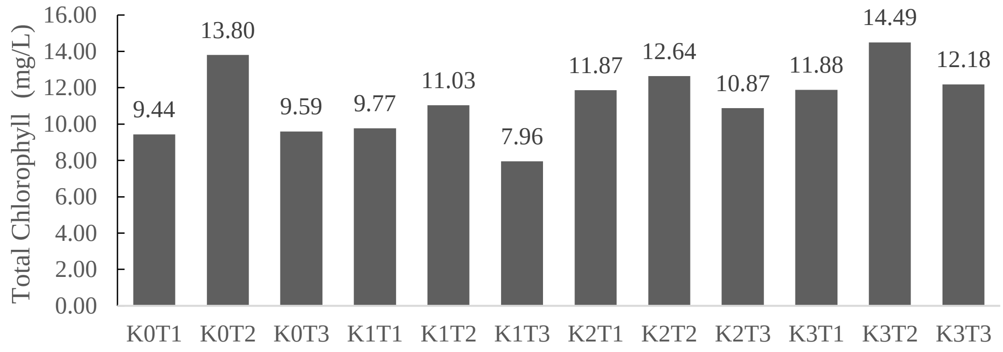


Figure 4.24. The contents of total chlorophyll of Tatsoi at harvest in various combinations of treatment, planting media composition and transplanting time

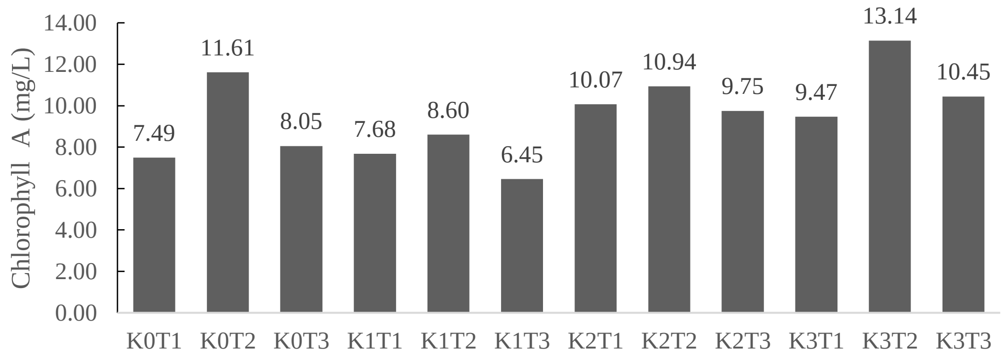


Figure 4.25.The contents of chlorophyll a of Tatsoi at harvest in various combinations of treatments, planting media composition and transplanting time

The highest chlorophyll b was obtained in K_1 with the average number of chlorophyll b was 2.01 mg/L (Figure 4.26), T_1 treatment with the average number of chlorophyll b was 2.07 mg/L (Figure 4.27), and the combination of K_1T_2 treatments with the average number of chlorophyll b was 2,43 mg/L (Figure 4.28). Moreover, the lowest chlorophyll b was obtained in K_2 treatment with the average number of chlorophyll b was 1.55 mg/L (Figure 4.26), T_3 with the average number of chlorophyll b was 1.48 mg/L (Figure 4.27), and the combination of K_2T_3 treatments with the average number of chlorophyll b was 1.13 mg/L (Figure 4.28).

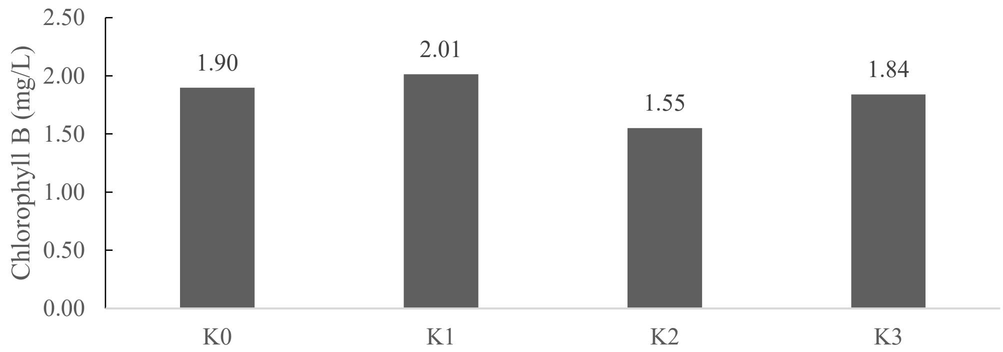


Figure 4.26. The effects of planting media composition on the contents of the chlorophyll b of Tatsoi at harvest

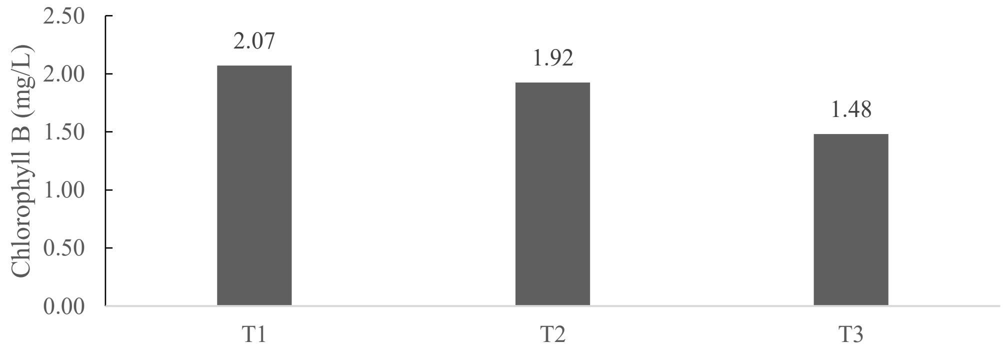


Figure 4.27. The effects of transplanting time on the content of chlorophyll b of Tatsoi at harvest

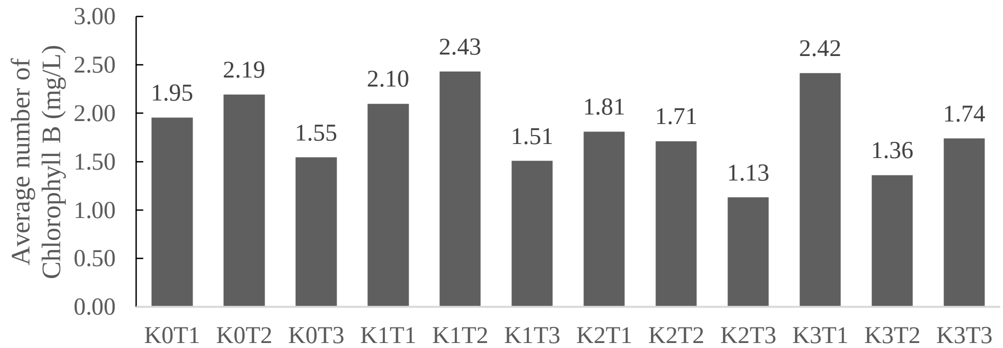


Figure 4.28. The content of chlorophyll b of Tatsoi at harvest in various combinations of treatment, planting media composition and transplanting time

4.1.7. Leaf Fresh Weight (g)

The results of LSD test showed that transplanting time was not significantly different from the leaf fresh weight variable. The highest leaf fresh weight was in K_2 treatment with the average leaf fresh weight was 41.92 g, T_3

treatment with the average leaf fresh weight was 7.41 g (Table 4.10), and the combination of K_2T_3 treatments with the average leaf fresh weight was 46.39 g (Figure 4.29). Moreover, the lowest leaf fresh weight was in K_0 treatment with the average leaf fresh weight was 22.98 g, T_1 treatment with the average leaf fresh weight was 29.84 g (Table 4.10), and the combinations of K_0T_1 treatments with the average leaf fresh weight was 19.75 g (Figure 4.29).

Table 4.10. LSD test results of planting media composition effect and transplanting time effect on the leaf fresh weight of Tatsoi at harvest

Planting Media Composition	Leaf Fresh Weight (g)	
K_0	22,98	c
K_1	28,35	bc
K_2	41,92	a
K_3	37,70	ab
LSD 0,05	11,70	
Transplanting time	Leaf Fresh Weight (g)	
T_1	29,84	a
T_2	30,96	a
T_3	37,41	a
LSD 0,05	10,13	

The numbers followed by the same letter in the same column were not significantly different in the 5% HSD test.

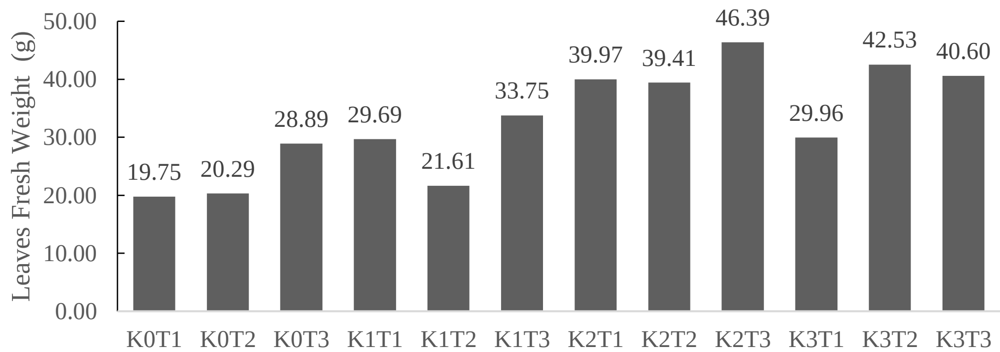


Figure 4.29. The leaf fresh weight of Tatsoi at harvest in various combinations of planting media composition and transplanting time treatments

4.1.8. Stem Fresh Weight (g)

The highest stem fresh weight was obtained in K_2 treatment with the average stem fresh weight was 5,79 g (Figure 4.30), T_3 treatments with the average stem fresh weight was 4.97 g (Figure 4.31), and the combination of K_2T_2 treatment with the average stem fresh weight was 6.07 g (Figure 4.32). Meanwhile, the lowest stem fresh weight was obtained in K_0 treatment with the average stem fresh weight was 3.97 g (Figure 4.30), T_1 treatment with the average stem fresh weight was 4.50 g (Figure 4.31), and the combination of K_0T_2 treatment with the average stem fresh weight was 3.42 g (Figure 4.32).

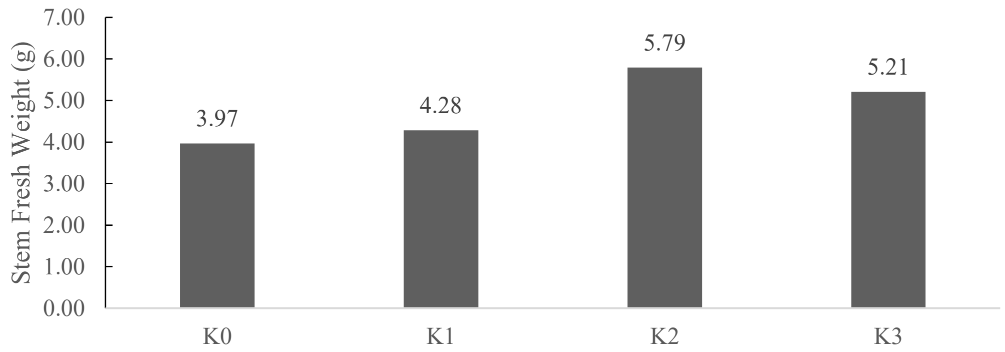


Figure 4.30. The effects of planting media composition on the stem fresh weight of Tatsoi at harvest

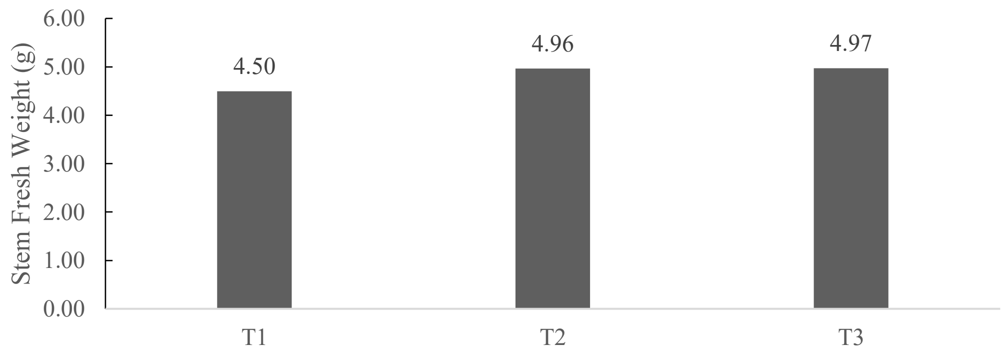


Figure 4.31. The effects of transplanting time on the stem fresh weight of Tatsi at harvest

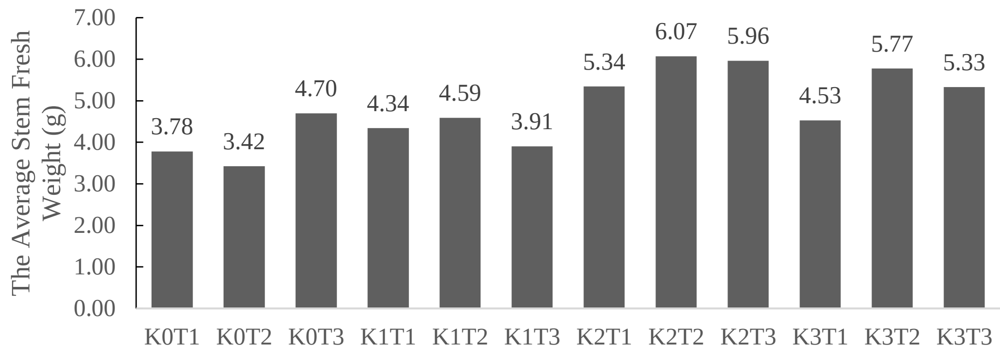


Figure 4.32. The stem fresh weight of Tatsoi at harvest in various combinations of planting media composition and transplanting time treatments

4.1.9. Root Fresh Weight (g)

The highest root fresh weight was in K_0 treatment with the average root fresh weight was 3.57 g (Figure 4.33), T_3 treatment with the average root fresh weight was 3.31 g (Figure 4.34), and the combination of K_0T_1 treatments with the average root fresh weight was 4.54 g (Figure 4.35). Moreover, the lowest root fresh weight was in K_1 treatment with the average root fresh weight was 1.63 g (Figure 4.33), T_2 treatment with the average root fresh weight was 2.29 g (Figure 4.34), and the combination of K_1T_2 treatments with the average root fresh weight was 1.18 g (Figure 4.35).

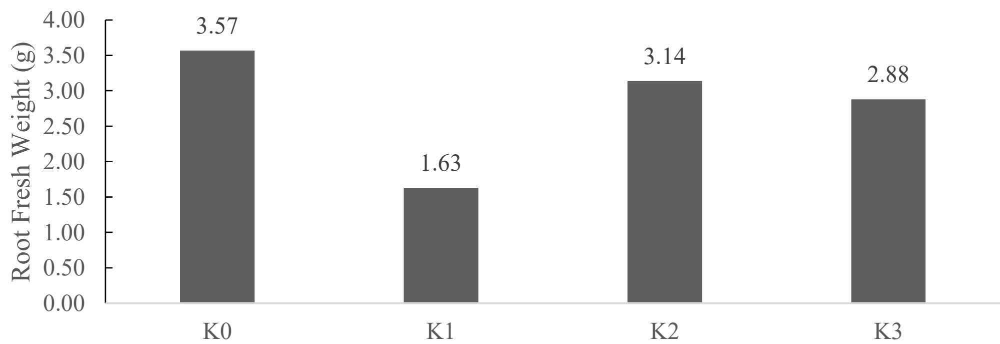


Figure 4.33. The effects of planting media composition on the root fresh weight of Tatsoi at harvest

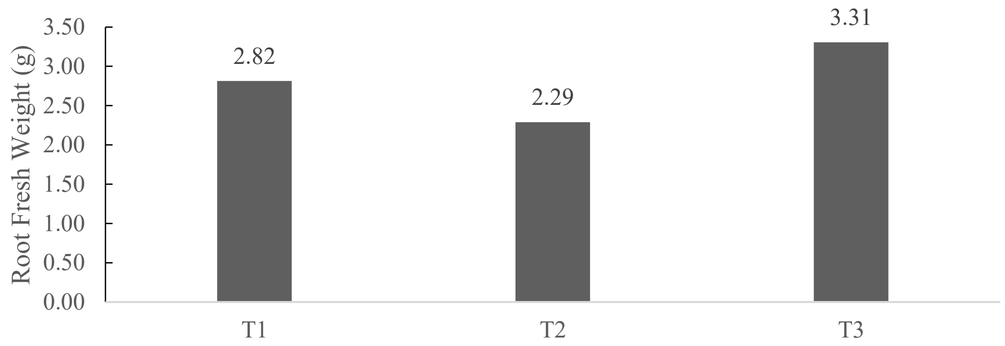


Figure 4.34. The effects of transplanting time on the root fresh weight of Tatsoi at harvest

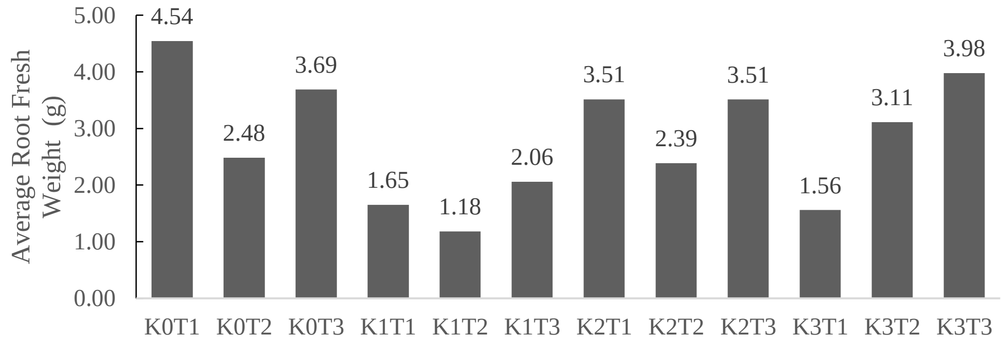


Figure 4.35. The root fresh weight of Tatsoi at harvest in various combinatios of planting media composition and transplanting time treatments

4.1.10. Leaf Dry Weight (g)

The results of LSD test presented that transplanting time treatment was not significantly different from the leaf dry weight variable. The highest leaf dry weight was in K_2 treatment with the average leaf dry weight was 3.21 g, T_3 treatment with the average leaf dry weight was 3.02 g (Table 4.11), and the combination of K_2T_3 treatments with the average leaf dry weight was 3.74 g (Figure 4.36). Besides, the lowest leaf dry weight was in K_0 treatment with the average leaf dry weight was 1.93 g, T_1 treatment with the average leaf dry weight was 2.33 g (Table 4.11), and the combination of K_0T_2 treatment with the average leaf dry weight was 1.71 g (Figure 4.36).

Table 4.11. The LSD test results of planting media composition effect and transplanting time effect on the leaf dry weight of Tatsoi at harvest

Planting Media Composition	Leaf Dry Weight (g)	
K_0	1,93	c
K_1	2,34	bc
K_2	3,21	a

K_3	2,81	ab
LSD 0,05	0,85	
Transplanting time	Leaf Dry Weight (g)	
T_1	2,33	a
T_2	2,37	a
T_3	3,02	a
LSD 0,05	0,73	

The numbers followed by the same letter in the same column were not significantly different in the 5% HSD test.

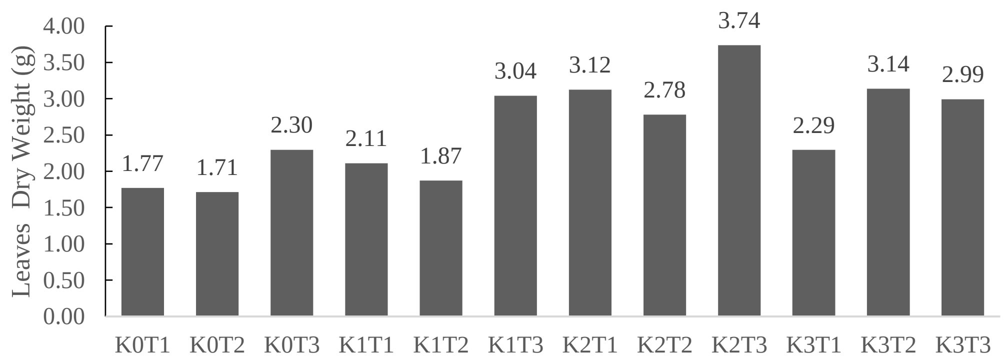


Figure 4.36. The leaf dry weight of Tatsoi at harvest in various combinations of planting media composition and transplanting time treatments

4.1.11. Stem Dry Weight (g)

LSD test results showed that the treatments of planting media composition, transplanting time and the interactions of the two variables were not significantly different from the stem dry weight variable. The highest stem dry weight was obtained in K_2 treatment with the average stem dry weight was 0,76 g (Figure 4.37), T_2 treatment with the average stem dry weight was 0,76 g (Figure 4.38), and the combination of K_2T_2 treatments with the average stem dry weight was 0.93 g (Figure 4.39). Meanwhile, the lowest stem dry weight was obtained in K_3 treatment with the average stem dry weight was 0.69 g (Figure 4.37), T_3 treatment with the average stem dry weight was 0,66 g (Figure 4.38), and the combination of K_0T_2 treatments with the average stem dry weight was 0.61 g (Figure 4.39).

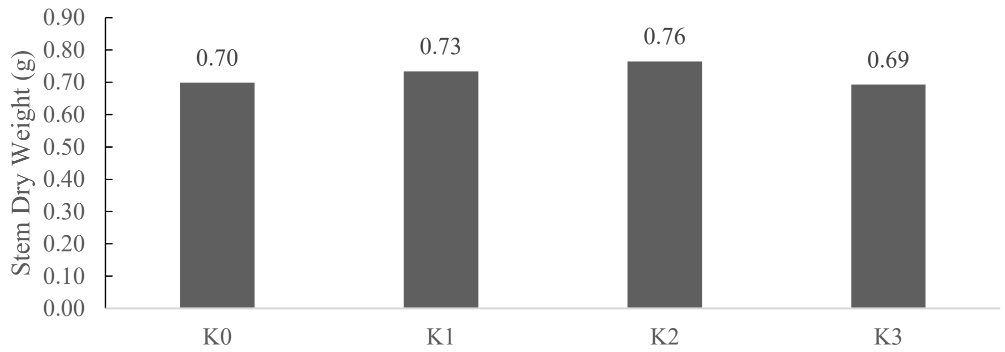


Figure 4.37. The effects of planting media composition on stem dry weight of Tatsoi at harvest

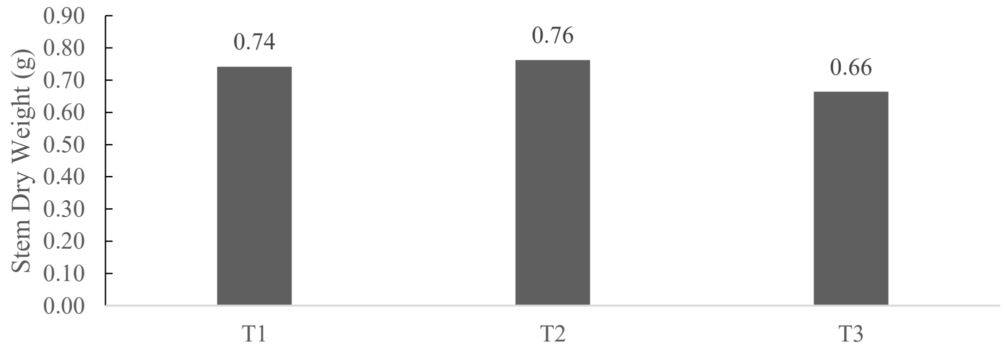


Figure 4.38. The effects of transplanting time on stem dry weight of Tatsoi at harvest

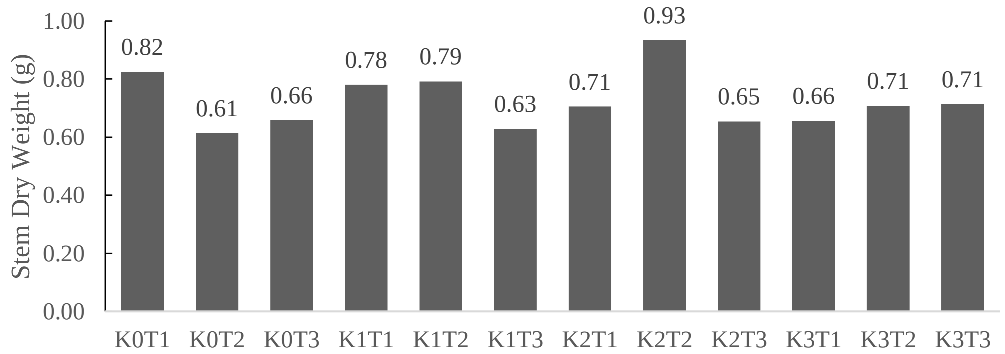


Figure 4.39. Stem dry weight of Tatsoi at harvest in various combinations of planting media composition and transplanting time treatments

4.1.12. Root Dry Weight (g)

The highest root dry weight was obtained in K_0 treatment with the average root dry weight was 0.63 g (Figure 4.40), T_3 treatment with the average root dry weight was 0.57 g (Figure 4.41), and the combination of K_0T_1 treatments with the average root dry weight was 0.82 g (Figure 4.42). Moreover, the lowest root dry weight was obtained in K_1 treatment with the average root dry weight was 0.25 g (Figure 4.40), T_2 treatment with the average root dry weight was 0.38 g (Figure 4.41), and the combination of K_1T_2 treatment with the average root dry weight was 0.17 g (Figure 4.42).

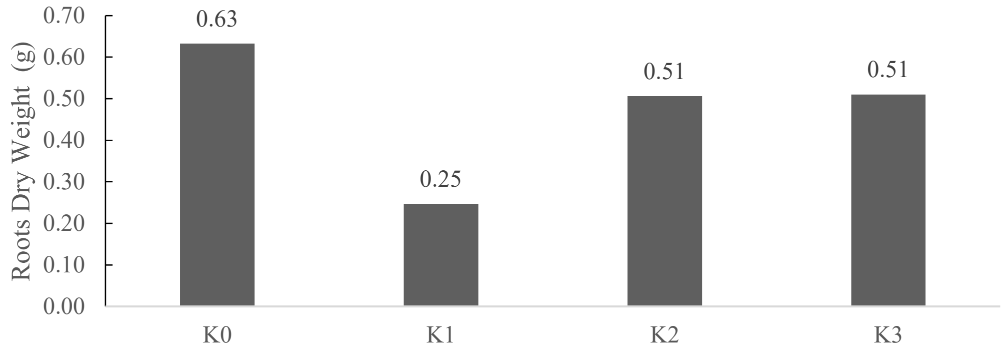


Figure 4.40. The effects of planting media composition on root dry weight of Tatsoi at harvest

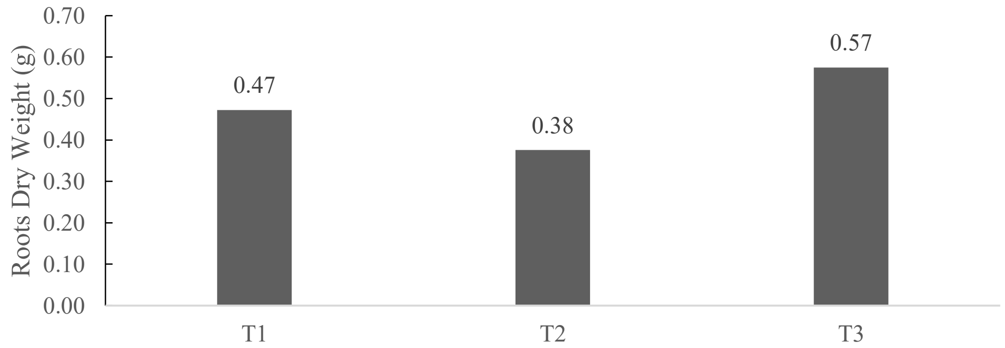


Figure 4.41. The effects of transplanting time on root dry weight of Tatsoi at harvest

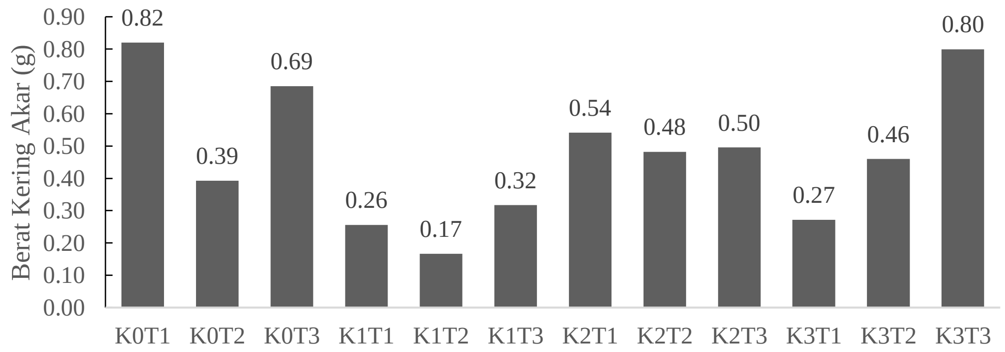


Figure 4.42. Root dry weight of Tatsoi at harvest in various combinations of planting media composition and transplanting time treatments

4.1.13. Leaves Moisture Content (%)

The highest leaves moisture content was in K_1 treatment with the average leaves moisture content was 96.99% (Figure 4.43), T_1 treatment with the average leaves moisture content was 95.29% (Figure 4.44), and the combination of K_1T_2 treatments with the average leaves moisture content was 97.11 % (Figure 4.45). Besides, the lowest leaves moisture content was obtained in K_3 treatment with the average leaves moisture content was 92.83% (Figure 4.43), T_3 treatment with the average leaves moisture content was 94.54% (Figure 4.44), and the combination of K_3T_3 treatments with the average leaves moisture content was 91.10% (Figure 4.45).

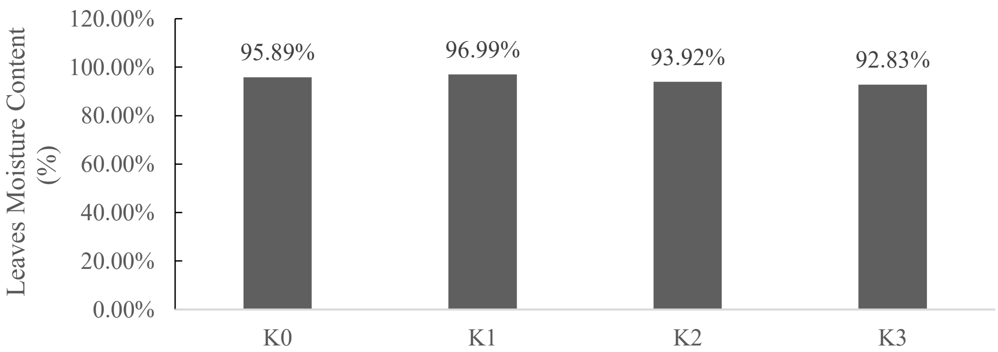


Figure 4.43. The effects of planting media composition on the moisture content of Tatsoi leaves at harvest

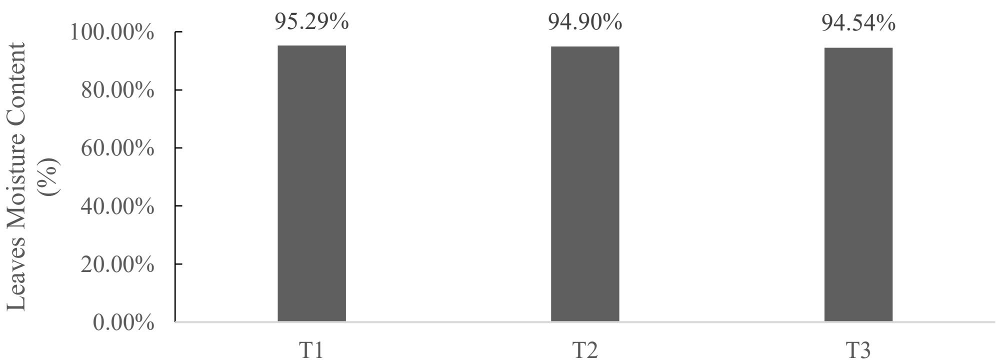


Figure 4.44. The effects of planting media composition on the moisture content of Tatsoi leaves at harvest

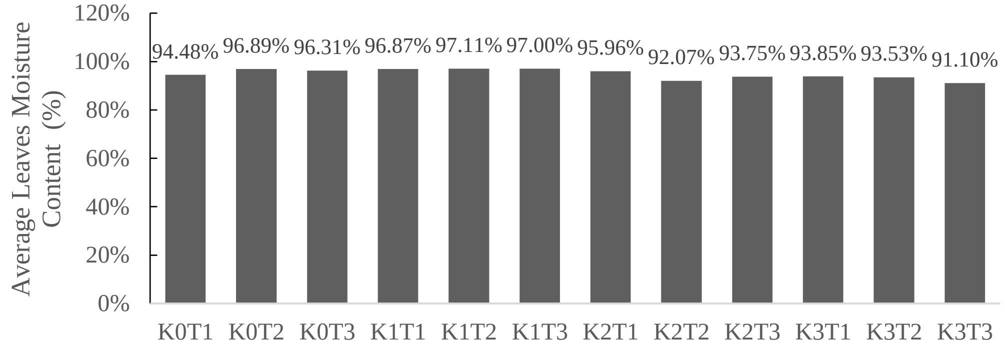


Figure 4.45. The moisture content of Tatsoi leaves at harvest in various combinations of planting media composition and transplanting time treatments

4.1.14. Shoot/Root Ratio

The highest shoot/root ratio was obtained in K_1 treatment with the average shoot/root ratio was 16.60 (Figure 4.46), T_3 treatment with the average shoot /root ratio was 13.42 (Figure 4.47), and the combination of K_1T_2 treatments with the average shoot /root ratio was 18.29 (Figure 4.48). Meanwhile, the lowest shoot /root ratio was obtained in K_3 treatment with the average shoot /root ratio was 10.28 (Figure 4.46), T_2 treatment with the average shoot /root ratio was 11.35 (Figure 4.47), and the combination of K_0T_2 treatments with the average shoot /root was 7.29 (Figure 4.48).

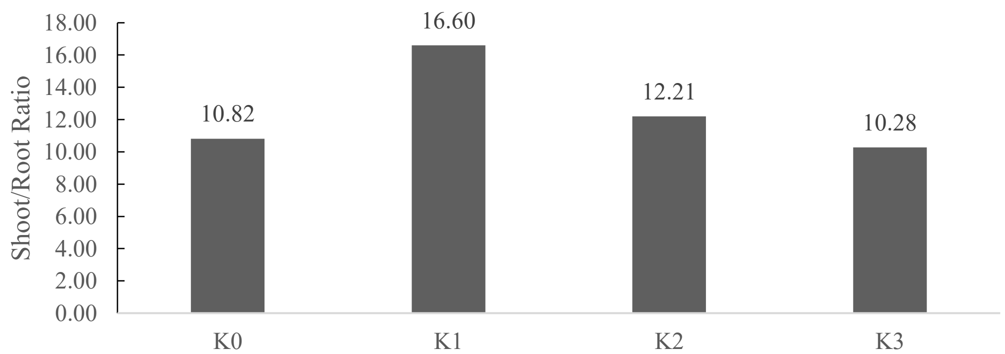


Figure 4.46. The effects of planting media composition treatment on the ratio of Tatsoi shoot/root at harvest

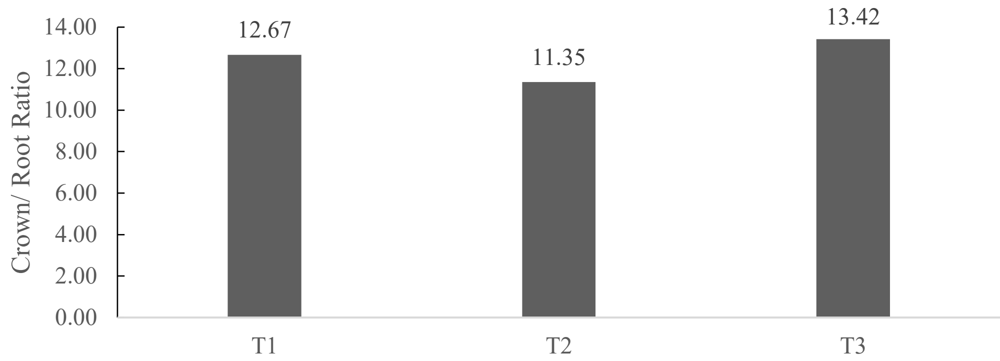


Figure 4.47. The effects of transplanting time treatments on the ratio of Tatsoi canopy/ root at harvest

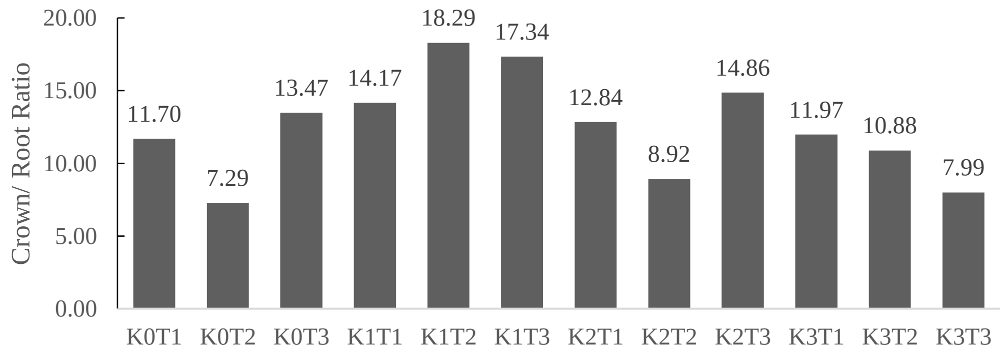


Figure 4.48. The ratio of Tatsoi canopy/ root at harvest in various combinations of planting media composition and transplanting time treatments

4.1.15. Harvest Index

The highest harvest index was in K_1 treatment with the average harvest index was 0.70, T_3 treatment with the average harvest index was 0.69, and combination of K_1T_3 treatments with the average harvest index was 0.77. Moreover, the lowest harvest index was in K_0 treatment with the average harvest index was 0.56, T_2 treatment with the average harvest index was 0.64, and the combination of K_0T_1 treatments with the average harvest index was 0.52. The results of LSD test showed that K_1, K_2, and K_3 treatments and T_1 and T_2 treatments were not significantly different (Table 4.12).

Table 4.12. LSD test results of planting media composition effect, transplanting effect and their interactions on harvest index of Tatsoi at harvest

Planting Media Composition	Harvest Index	
K_0	0,56	b
K_1	0,70	a
K_2	0,69	a
K_3	0,69	a

LSD 0,05	0,05	
Transplanting Time	Harvest Index	
T_1	0,65	b
T_2	0,64	b
T_3	0,69	a
LSD 0,05	0,04	
Interaction of Planting Media Composition and Transplanting Time	Harvest Index	
K_0T_1	0,52	g
K_0T_2	0,58	fg
K_0T_3	0,59	efg
K_1T_1	0,67	bcd
K_1T_2	0,65	cdef
K_1T_3	0,77	a
K_2T_1	0,72	abc
K_2T_2	0,61	def
K_2T_3	0,74	ab
K_3T_1	0,67	bcd
K_3T_2	0,72	abc
K_3T_3	0,67	bcde
LSD 0,05	0,08	

The numbers followed by the same letter in the same column were not significantly different in the 5% HSD test.

4.2. Discussion

Based on the results of the research, on the plant height variable when 16-37 DAS (Figure 4.3), plants still adapted after transplanting while at 40-58 DAS, the plants were able to adapt well to the surrounding environment. At harvest, the highest average plant height was obtained in K_2 treatment (Figure 4) with the composition of soil, husk charcoal and cow manure (6:2:2) and T_1 treatment (Figure 4.4) with the transplanting time at 7 DAS. Planting media added with rice husk charcoal and cow manure in a balanced amount could increase the height of Tatsoi. Similarly, Musnawar (2009) states that the availability of sufficient macro and micro nutrients would help to facilitate plant metabolic process and could stimulate plant height growth. The addition of manure could increase the availability of nutrients, such as N, P, K, S, Ca, Mg, Na, Fe, Cu, and Mo. The addition of these nutrients could also support plant growth. The characteristics of cow manure were also able to improve the nature of the soil which was a growing medium for plants. The addition of husk charcoal could also increase plant height growth. This is due to the element silica (Si) in rice husk charcoal which is able to improve environmental and plant conditions. Amrullah (2014) asserts that elemental silica can improve the physical properties of plants, especially in the stem so that plants are strong. Firmansyah *et al.* (2009) found that in Pakcoy, transplanting age of 8 days tended to provide a higher adaptive capacity for plant height growth. Besides, Schrader (2000) states that transplanting at a younger plant age can reduce the stress effect after transplanting. In younger plants, the plant roots were not very broad so that the potential for root breaking was reduced when removing plants during transplanting. As a result, younger plants can adapt more quickly to the environmental conditions due to the lower stress effect after transplanting.

The highest number of leaves (Figure 4.8 and Figure 4.9), canopy width (Table 4.6), and canopy area (Figure 4.16 and Figure 4.17) was obtained in K_2 treatment with soil composition, husk charcoal, and cow manure (6:2:2) and T_3 treatment with transplanting time at 13 DAS. In the variable number of leaves, when the plants were 16-22 DAS (Table 4.4), the plants were still adapting after transplanting. Meanwhile, at 25-58 DAS, the plants were able to adapt well to the surrounding environment. The macro and micro nutrients contained in cow manure, such as N, P, K, S, Ca, Mg, Na, Fe, Cu, and Mo were elements that are constituent components of many compounds in plant tissues which were also plays a role in plant metabolic activities (Lakitan, 2015). Therefore, the addition of these elements could stimulate plant metabolic processes, including the process of cell division, cell elongation, and cell differentiation that increased plant growth and the formation of plant organs, one of which was leaves. The addition of rice husk charcoal containing silica could increase the number of leaves. This was because the element silica was able to increase the process of photosynthesis in the leaf organ. The structure of husk charcoal was able to improve the physical properties of the soil which could increase the availability of macro nutrients for plants, thereby allowing an increase in the number of leaves (Dharmasika *et al.*, 2019). The older the seedling, the more leaves would be and the leaf surface area would also increase. Plant growth could be attributed to the number of leaves formed where the increase in the number of leaves occurred because the seeds were able to adapt to environmental conditions and were able to carry out the photosynthesis process properly by utilizing available nutrients, water, and CO2. Moreover, the vegetative growth phase at the age of older seedlings was faster where in this phase it can stimulate leaf growth because the plant is able to produce more growth hormone (Ervina *et al*., 2016). The growth and development of the number of leaves was directly proportional to the growth and development of the canopy width and the canopy area so that the increase in the number of leaves affected the increase in the canopy width and the canopy area. Vice versa, the reduction in the number of leaves affected the reduction in the canopy width and the canopy area.

In Table 4.5, it could be seen that at 16 DAS to 22 DAS the highest canopy width was found in T_2 treatment with the transplanting time at 10 DAS. However, at 25 DAS until harvest time (Table 4.6), the highest canopy width was found in T_3 treatment with the transplanting time at 13 DAS. At the beginning of growth after transplanting, T_3 treatment had the lowest canopy width at 16 DAS and 19 DAS, then at 22 DAS T_1 treatments with transplanting time at 7 DAS had the lowest canopy width until harvest. This indicated that seedlings transplanted at an older age had a smaller canopy width than seedlings transplanted at a younger age at the beginning of growth after transplanting. In this phase, the older seedlings were still adapting to environmental conditions, in contrast to the younger seedlings where the seeds had been transplanted first so that they were able to adapt to environmental conditions. Therefore, at 25 DAS until harvest, the older seedling was able to adapt to environmental conditions and had a faster growth rate than the younger seedlings.

Based on the results of the research on the greenness of the leaves (Figure 4.21 and Figure 4.22), total chlorophyll (Table 4.9), and chlorophyll a (Table 4.9), the highest results were obtained in the K_3 treatment with the composition of soil, husk charcoal, and cow manure (6: 1:3) and T_2 treatment with transplanting time at 10 DAS. Moreover, cow manure contained N element so that the application of cow manure could increase the chlorophyll content followed by an increase in the greenness of the leaves. Giving husk charcoal in planting media could make the use of cow manure more effective. Because husk charcoal had a function as a nutrient binder that could be released slowly according to plant needs (Komaryati *et al*., 2003). This binding of nutrients by husk charcoal made the nutrients available to plants in a balanced amount so that the photosynthesis process could run optimally. The optimization of the photosynthesis process was related to the chlorophyll content in the plant and the greenness of the leaves. Therefore, leaf color could reflect the rate of photosynthesis of a plant, where the greener the leaves contained the more chlorophyll, so the higher the rate of photosynthesis was (Firmansyah *et al*., 2009). Transplanting at a too old seedling age could potentially cause the plant to experience nutritional deficiencies and quickly enter the generative phase while transplanting at a too young age, plants had the potential to be stressed after transplanting because the roots, stems, and the leaves were not strong yet (Muharram *et al*., 2020). Therefore, it took a suitable transplanting time, not too you and not too old so that when transplanting the plants were strong and able to absorb nutrients well and the plants could grow well. The growth of this plant could not be separated from the process of photosynthesis which required chlorophyll in the process so that the transplanting time could affect the chlorophyll content in plants and the level of leaves greenness.

From the results obtained in Figure 4.26 and Figure 4.27, the highest chlorophyll b was in K_1 treatment with a composition of soil, husk charcoal, and cow manure (6:3:1) and T_1 with transplanting time at 7 DAS. The element nitrogen was needed in the synthesis of chlorophyll, including the synthesis of chlorophyll b. Cow manure contained 2.33% nitrogen (Andayani and Sarindo, 2013) so that the addition of cow manure could increase the chlorophyll content b. The nature of husk charcoal that could bind nutrients could maximize the use of cow manure, so that the photosynthesis process could run well (Komaryati *et al*., 2003). A younger transplanting age gave plants a fairly high adaptive ability to environmental conditions (Firmansyah *et al*, 2009), which could encourage better vegetative growth. This vegetative growth was the result of the photosynthesis process, where chlorophyll b played a role in it.

Leaf fresh weight (Table 4.10) and stem fresh weight (Figure 4.30 and Figure 4.31) were highest in K2 treatment with soil composition, husk charcoal, and cow manure (6:2:2) and T_3 with transplanting time at 13 DAS. K_2 and T_3 Treatments also produced the highest number of leaves, canopy width, and canopy area, which meant that there was a relationship between leaf number and leaf fresh weight. Similarly, Polii (2009) found that an increase in the number of leaves could be followed by an increase in fresh weight. The content of macro nutrients in cow manure was able to stimulate the growth of vegetative organs and increase the productivity of leaves vegetable plants. The element N was a constituent in chlorophyll which played a role in the photosynthesis process; element P played a role in reactions in photosynthesis, respiration, and other metabolic processes; and the element K had an important role in the process of opening and closing the stomata (Lakitan, 2015). The role and function of these macro nutrients were used in plant metabolism processes and the formation of plant organs, including the formation of leaves and stems. According to Lingga (2008), plant fresh weight was influenced by water absorption and the availability of nutrients in the growing media. The relatively crumbly and porous nature of husk charcoal provided space for water in the growing media so that plants were able to absorb water more optimally (Ekaputra *et al.*, 2016). Moreover, older planting age was able to adapt more quickly to plant stagnation in the initial phase of growth. The advantage of transplanting plant seeds at the age of 14 DAS was that it could reduce growth cessation and damage to the roots of stone seedlings when transplanting into the land (Alfandi *et al.*, 2017). Therefore, with a strong root system, plants were able to form other organs so that the transplanting time could affect the fresh weight of the plant.

The highest fresh root weight (Figure 4.33 and Figure 4.34) was obtained in K_0 treatment with a composition of soil and cow manure (9:1) and T_3 with transplanting time at 13 DAS. In optimal growing media conditions, the plant root system was controlled by genetic traits. However, there were several factors that could influence the pattern of root distribution, such as aeration, water availability, and nutrient availability. Planting media conditions that were not optimal could result in deviant root growth so that the roots would tend to go to places that contained sufficient water and nutrients (Lakitan, 2015). K_0 treatment was not given the additional husk charcoal so that in this treatment the growing media did not have the characteristics and husk charcoal characteristics as a soil enhancer. As a result, it produced larger roots than other treatments but was not followed by an increase in canopy width, where the K_0 treatment produced the lowest fresh weight of leaves and stems. This reflected the ability of the lowest K_0 growing medium in supplying water and nutrients. Besides, plant growth was influenced by the root system and was reflected in the growth of the canopy. T_3 treatment resulted in the highest fresh weight of leaves, stems and roots. High root growth was followed by high canopy growth, resulting in an ideal plant. Transplanting would produce a sturdy and ideal plant if root restoration was going well. At that age the seeds had roots that were perfect and strong enough to be transplanted. Strong roots would absorb nutrients and water better so as to reduce growth barriers due to the transplanting process (Irawati and Widodo, 2017).

The highest leaf dry weight (Table 4.11) was obtained in K_2 treatment with soil composition, husk charcoal, and cow manure (6:2:2) and T_3 with transplanting time at 13 DAS. In cow manure contained macro and micro nutrients which played a role in plant dry weight. The provision of macro and micro nutrients must be balanced and in the right composition so that plant growth was not hampered (Sukasana *et al.*, 2019). Lakitan (2015) stated that the accumulation of organic compounds resulting from the photosynthesis process was reflected in the dry weight of the plant. Besides, Polii (2009) asserts that the leaf organ is a sink or a gathering place for photosynthesis in leaf vegetable plants. Therefore, in Tatsoi, leaf dry weight showed the majority of photosynthetic accumulation. The ability of plants to absorb nutrients, water, and sunlight was directly proportional to the dry weight they produce. With the provision of husk charcoal, it could increase the availability of nutrients and water in the planting media so that the provision of husk charcoal could increase the dry weight of the plant (Akmal and Simanjuntak, 2019). According to Xu et al. (2010), transplanting done on older seedlings could accelerate the ability to adapt to the environment. The faster the plant adapts, the higher the plant productivity which could be reflected in the dry weight of the leaves as a result of photosynthetic accumulation.

The highest stem dry weight (Figure 4.37 and Figure 4.38) was obtained in K_2 treatment with the composition of soil, husk charcoal and cow manure (6:2:2) and T_2 treatment with the transplanting time at 10 DAS. The composition of the growing media used was balanced so that the highest stem dry weight was obtained on the same media as the plant height and the highest stem fresh weight. The nutrient content of cow manure and the characteristics of husk charcoal as a soil enhancer have formed the right planting media for the growth of Tatsoi. The dry weight of the stems showed the accumulation of photosynthetic in the stems. The transplanting time at 10 DAS was suitable for increasing photosynthetic accumulation in stems where at the time of transplanting, the plants were neither too young nor too old, so that at the time of the removal the risk of root uprooting was not too great and the seedlings at 10 DAS were strong enough to overcome the post-transplant stresses. Therefore, plants were able to carry out the process of photosynthesis to produce photosynthesis. Photosynthetic produced was used by plants for cell division and development. Cell division and development could stimulate plant height growth, leaf formation, and root development so that it would increase plant dry weight (Ervina *et al*., 2016).

The highest root dry weight (Figure 4.40 and Figure 4.41) was obtained in K_0 treatment with a composition of soil and cow manure (9:1) and T_3 with transplanting time at 13 DAS. Root dry weight was the accumulation of photosynthetic distribution in the roots. A high root dry weight, but not followed by a high canopy dry weight meant that photosynthetic tended to be distributed to the roots. This indicated that the roots needed a wider structure to absorb water and nutrients, which could indicate that the available nutrients and water in the planting media were not optimal. A good root system will produce good plant growth (Ervina *et al*., 2006). This could be seen in the T_3 treatment of the highest plant fresh weight. In the T_3 treatment, the height of root dry weight was followed by leaf dry weight. Roots as organs for absorbing water and nutrients and leaves as product organs and sites of photosynthesis could show that the distribution of photosynthetic yields was balanced in T_3 treatment. At the of 13 DAS, the plants were strong enough for the transplanting process. Even though the roots were cut off during the transplanting process, the leaves of the plants were able to carry out photosynthesis well because they had a larger area, so the photosynthetic results could be used for the formation of new root tissue.

The highest leaves moisture content (Figure 4.43 and Figure 4.44) was obtained in treatment K1 with a composition of soil, husk charcoal, and cow manure (6:3:1) and T_1 treatment with transplanting time at7 DAS. According to Hanafiah (2007), organic matter can increase the pore space of the soil which functions as a source of water and air, as well as a space for root penetration. Anjeliza *et al.* (2013) state that husk charcoal has a porous nature and is able to store water well. The structure of the crumb and sterile husk charcoal can create sufficient soil pore space for plant root growth. Moreover, the existence of a planting media structure that was able to hold water and good root growth could maximize the water absorption process so that it would affect the water content of the plant. Besides, Sharma *et al.* (2005) assert that transplanting on older plants had the potential for root damage during the transplanting process. This root damage could reduce the effective area of the roots and remove root hairs that were more active in water absorption so that it had an impact on the water content of the plant.

The highest shoot/root ratio (Figure 4.46 and Figure 4.47) and harvest index (Table 4.12) were obtained in K_1 treatment with a composition of soil, husk charcoal, and cow manure (6:1:3) and T_3 treatment with transplanting time at13 DAS. Moreover, the shoot/root ratio reflected the growth rate or distribution of photosynthetic yields in plants (Rusmana, 2017). The results of this photosynthesis came from the absorption of nutrients carried out by plants so that the nutrient content and environmental conditions could affect the shoot/root ratio. The combination of K_1 planting media composition had sufficient nutrient content from cow manure plus the structure of husk charcoal which was able to improve the properties of the planting media so that plants were able to form vegetative organs properly. The plant organs harvested in Tatsoi were leaves, so that an increase in the shoot/root ratio could increase the harvest index. The harvest index showed the distribution of photosynthetic yields in plant organs. During the transplanting process, the age of the plant was inversely proportional to the number of roots left in the seeding medium (Rayan, 2009). When the age of the seedlings was older, the roots had also become stronger to be able to adapt to environmental conditions. This is related to the ability to absorb water and nutrients for photosynthesis. Older seedlings also had a larger number of leaves and leaf surface area, thereby increasing the rate of photosynthesis and the formation of photosynthetic products. The photosynthetic results would be used in the process of forming vegetative organs in plants (Sahila, 2006).

CHAPTER 5
CONCLUSIONS AND SUGGESTION

5.1. Conclusions

Based on the results of the study it can be concluded that:

1. The composition of planting media soil, husk charcoal and cow manure which gave the best effect on the growth and yield of Tatsoi was found in a 6:2:2 ration, which was based on the highest yield on plant height, number of leaves, canopy width, canopy area, leaf fresh weight, stem fresh weight, leaf dry weight and stem dry weight.
2. Transplanting time at 13 DAS gave the best effect on the growth and yield of Tatsoi, which was based on the highest yield on the number of leaves, canopy width, canopy area, leaf fresh weight, stem fresh weight, root fresh weight, leaf dry weight, root dry weight, root canopy ratio and harvest index.

5.2. Suggestion

Based on the results of the study, it can be suggested to use the composition of the planting media of soil, husk charcoal, and cow manure with a ratio of 6:2:2 and transplanting time of 13 DAS in planting Tatsoi.

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