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Effectiveness of Difference Soil and Manure Mixture on Growth and Yield of Bak Choy Planted in Bags

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Abstract

The study of soil groups, soil types, and soil characteristics is very important for the cultivation of crops in Cambodia. Selecting soil types that are not suitable for the type of crop will result in poor crop growth, slowness, and low yields. In the same way that the cultivation of crops in the production of vegetable crops is the same, that is, choosing the type of soil that is suitable for the crop is a point to consider and pay attention to. Due to some geographical areas in some communes, the topography is sandy or rocky, and the soil is hard, making it difficult for farmers to prepare parallel cultivable land where some people have less land and try to cultivate it using plastic buckets. Cement or bags to grow as a vegetable or grow to get some yield just to meet daily food needs; avoid spending money to buy vegetables from the market. Bak Choy is a crop that can grow on almost any type of soil, especially alluvial soils. It also has many benefits for the body, such as strengthening bones, the immune system, cancer cells, and so on. However, the cultivation of kale also encounters a number of problems, such as poor growth, low yields, pests, and diseases, especially the technique of choosing the wrong soil mixture, which affects the growth and yield. Not so good. A comparative study of different levels of soil and manure mixes on the growth and yield of Bak Choy in AmpilTapok commune, Orang Ov district, ThbongKhnum province. On the growth and yield of the first treatment (T1), the use of soil mix with cow dung, the second treatment (T2), the use of soil mix with chicken manure, and the third treatment (T3), the use of soil mix with pig manure is grown using a mixture of soil mixed with chicken manure (T2), which grows well and gives high yields in other ways.

Keywords

Different soil, manure mixture, growth, yield, Bak Choy.



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1. INTRODUCTION

Cambodia's economy is growing remarkably, and economic growth depends heavily on agriculture, but we see that agriculture is growing remarkably day by day as most people learn the techniques. gradual cultivation, combined with the effort of farming for a living. In terms of topography, Cambodia is divided into three major regions: highlands, lowlands, and mountains. In that case, if we talk about the types of soils for growing crops, they are divided into 11 groups, and each group has different physical and chemical characteristics. The study of soil groups, soil types, and soil characteristics is very important for the cultivation of crops in Cambodia. Selecting soil types that are not suitable for the type of crop will result in poor crop growth, slowness, and low yields. In the same way that the cultivation of crops in the production of vegetable crops is the same, that is, choosing the type of soil that is suitable for the crop is a point to consider and pay attention to. According to research, vegetable production in Cambodia has grown significantly during the Sangkum Reas Niyum era. Presently, there is a demand for tons of vegetables sourced locally and imported from neighboring countries each year.

This research is very important, as we can determine the suitable soil mixture for the growth and yield of Bak Choy. The results of this study allow us to better understand the appropriate soil mix, growth, and yield of Bak Choy, which makes the cultivation successful.

The objectives of this study are to find out the suitable soil mixtures for the growth and yield of Bak Choy and to analyze the economic efficiency of Bak Choy cultivation planted in bags.

2. METHODOLOGY

The experiment was conducted using a randomized complete block design (RCBD) consisting of 4 replications and 3 treatments, for a total of 12 plots.

- Total experimental land size: 7.5 m × 4 m (30 m²)
- Total plot size: 1.50 m × 1.00 m (1.5 m²)
- The space between the treatment and the replication: 0.5 m
- The space between row: 20 cm
- The space between bush: 15 cm
- Bak Choy is planted 5 rows in each plot, and each row has 10 bushes equal to 50 bushes (one bag one bush equal to 50 bags).
- The bag has a diameter of 17 cm and a height of 22 cm.

The treatments (T) in this experiment are described as follows:

- T1: use 4 parts topsoil mixture, 2 parts rice husk charcoal, and 1 part cow dung
- T2: use 4 parts topsoil mixture, 2 parts rice husk charcoal, 1 part chicken manure
- T3: use 4 parts topsoil mixture, 2 parts rice husk charcoal, 1 part pig manure

3. RESULTS AND DISCUSSION

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Height of Bak Choy at growing stage (cm)

The result of analysis of variance (ANOVA) showed that the stem height of Bak Choy in the three growing stages was statistically significant at a 95% reliability level (sig 0.026*). The result showed that the second treatment (T2) has the highest stem height at 17.41 cm, while the first (T1) and third treatments (T3) have the same height at the same growth stage, which is the statistical value. The first treatment (T1) has a height of 14.14 cm, and the second treatment (T2) has a height of 12.81 cm.

Table 1. Height of Bak Choy at growing stage (cm)

SV	d.f.	SS	MS	F value	p
Treatment	2	44.83	22.40	7.14	0.026*
Replication	3	0.011	0.004	0.001	1.00 ^{ns}
Error	6	18.81	3.13	-	-
Total	11	-	-	-	-

CV =16.26%

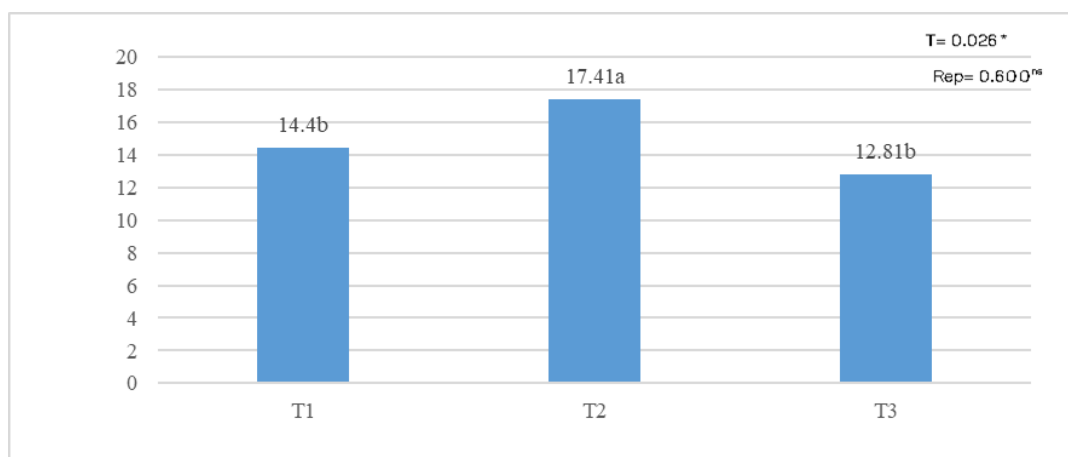


Figure 1. Height of Bak Choy at growing stage (cm)

As a result, the use of a mixture of topsoil and chicken manure has increased the original height of the Bak Choy, so farmers should choose to grow Bak Choy using a mixture of topsoil mixed with chicken manure to increase the stem height of the Bak Choy.

Height of Bak Choy at harvesting stage (cm)

According to the ANOVA table, the height of Bak Choy at harvesting stage showed that the Pro/Sig value of the treatment equal to 0.00** is to accept H1 (alternate hypothesis) by rejecting H0 (null hypothesis). This means that the three treatments are statistically different at a percentage of 99% confidence in the stem height of 0.00 < 0.05. This result showed that the use of different mixtures of topsoil and manure varies the plant height.

Table 2. Height of Bak Choy at harvesting stage (cm)

SV	d.f.	SS	MS	F value	p
Treatment	2	121.45	60.72	283.78	0.000*
Replication	3	1.94	0.65	3.03	0.115 ^{ns}
Error	6	1.28	0.21	-	-
Total	11	-	-	-	-

CV =17.83%

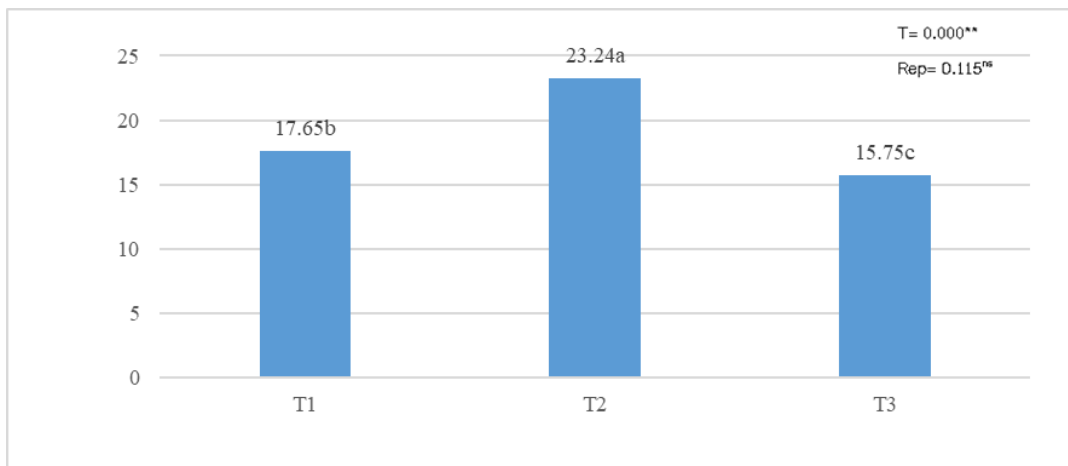


Figure 2. Height of Bak Choy at harvesting stage (cm)

The results of this figure showed that the height of Bak Choy at the time of harvesting from three treatments differs statistically at a level of 99% reliability (sig. 0.000**). The results show that Bak Choy grown using a soil mixture mixed with chicken manure has a stem height of 23.24 cm; a soil mixture mixed with cow dung yielded a height of 17.65 cm; and a soil mixture mixed with pig manure had the lowest height of 15.75 cm at the harvesting stage. The results show that the highest treatment at the time of harvesting Bak Choy is the second treatment, while the third treatment has the lowest stem height compared to other treatments. Farmers should choose to grow Bak Choy using a mixture of soil mixed with chicken manure to get a tall stem, which is popular with cultivators.

Leaf width of Bak Choy at growing stage (cm)

According to the ANOVA table, the leaf width of Bak Choy at growing stage showed that the Pro/Sig value of the treatment equal to 0.006** is to accept H1 (alternate hypothesis) by rejecting H0 (null hypothesis). This means that the three treatments are statistically different at a percentage of 99% confidence in the leaf width of 0.006<0.05. This result showed that the use of different mixtures of topsoil and manure varies the plant leaf width.

Table 3. Leaf width of Bak Choy at growing stage (cm)

SV	d.f.	SS	MS	F value	p
Treatment	2	15.17	7.58	13.46	0.006**
Replication	3	0.04	0.01	0.02	0.995ns
Error	6	3.38	0.56	-	-
Total	11	-	-	-	-

CV =20.70%

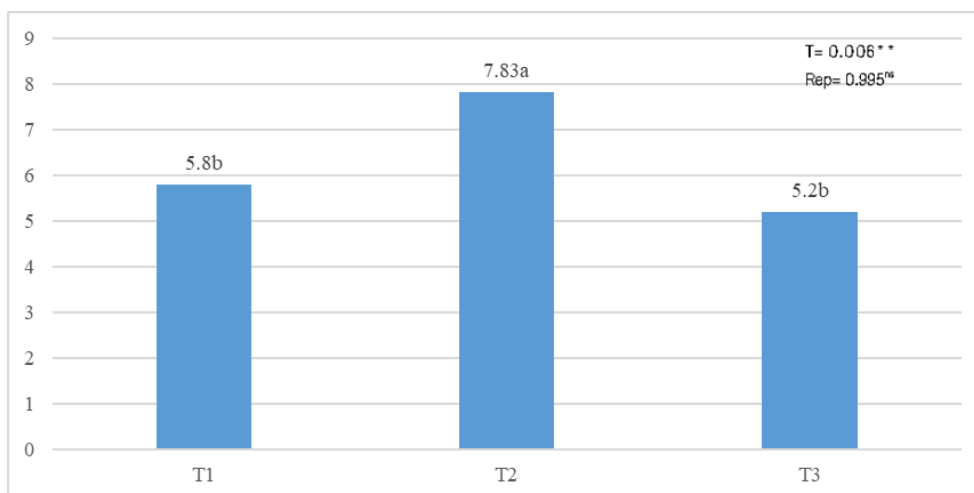


Figure 3. Leaf width of Bak Choy at growing stage (cm)

The results of this figure showed that the leaf width of Bak Choy at growing stage from three treatments differs statistically at a level of 99% reliability (sig. 0.006**). The results show that the second treatment (T2) has a high leaf width of 7.83 cm; and the first (T1) and third (T3) treatments have a similar leaf width of 5.8 cm for T1 and of 5.2 cm for T3. The results show that the highest treatment at growing stage of Bak Choy is the second treatment, while the first and third treatments are non-significantly different.

Leaf width of Bak Choy at harvesting stage (cm)

According to the ANOVA table, the leaf width of Bak Choy at harvesting stage showed that the Pro/Sig value of the treatment equal to 0.00** is to accept H1 (alternate hypothesis) by rejecting H0 (null hypothesis). This means that the three treatments are statistically different at a percentage of 99% confidence in the leaf width of 0.000<0.05. This result showed that the use of different mixtures of topsoil and manure varies the plant leaf width.

Table 4. Leaf width of Bak Choy at harvesting stage (cm)

SV	d.f.	SS	MS	F value	p
Treatment	2	21.06	10.53	15.44	0.000**
Replication	3	0.76	0.25	0.37	0.775ns
Error	6	4.09	0.68	-	-
Total	11	-	-	-	-

CV =18.59%

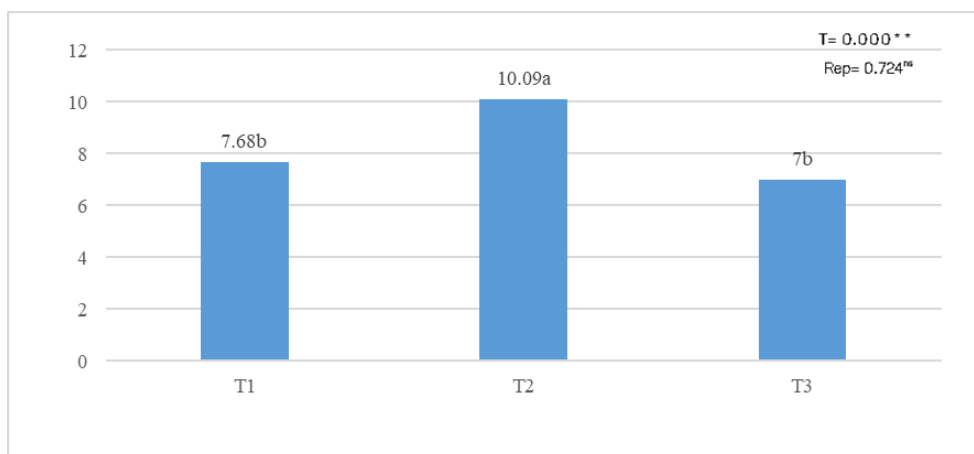


Figure 4. Leaf width of Bak Choy at harvesting stage (cm)

The results of this figure showed that the leaf width of Bak Choy at harvesting stage from three treatments differs statistically at a level of 99% reliability (sig. 0.000**). The results show that the second treatment (T2) has a high leaf width of 10.09 cm; and the first (T1) and third (T3) treatments have a similar leaf width of 7.68 cm for T1 and of 7.0 cm for T3. The results show that the highest treatment at harvesting stage of Bak Choy is the second treatment, while the first and third treatments are non-significantly different. Therefore, farmers should choose to grow Bak Choy using a soil mixture mixed with chicken manure to get a good leaf width, which helps to increase the yield of Bak Choy.

Leaf length of Bak Choy at growing stage (cm)

According to the ANOVA table, the leaf length of Bak Choy at growing stage showed that the Pro/Sig value of the treatment equal to 0.000** is to accept H1 (alternate hypothesis) by rejecting H0 (null hypothesis). This means that the three treatments are statistically different at a percentage of 99% confidence in the leaf width of 0.000<0.05. This result showed that the use of different mixtures of topsoil and manure varies the plant leaf length.

Table 5. Leaf length of Bak Choy at growing stage (cm)

SV	d.f.	SS	MS	F value	p
Treatment	2	25.19	12.59	8.12	0.02*
Replication	3	1.30	0.43	0.28	0.838ns
Error	6	9.30	1.55	-	-
Total	11	-	-	-	-

CV =20.19%

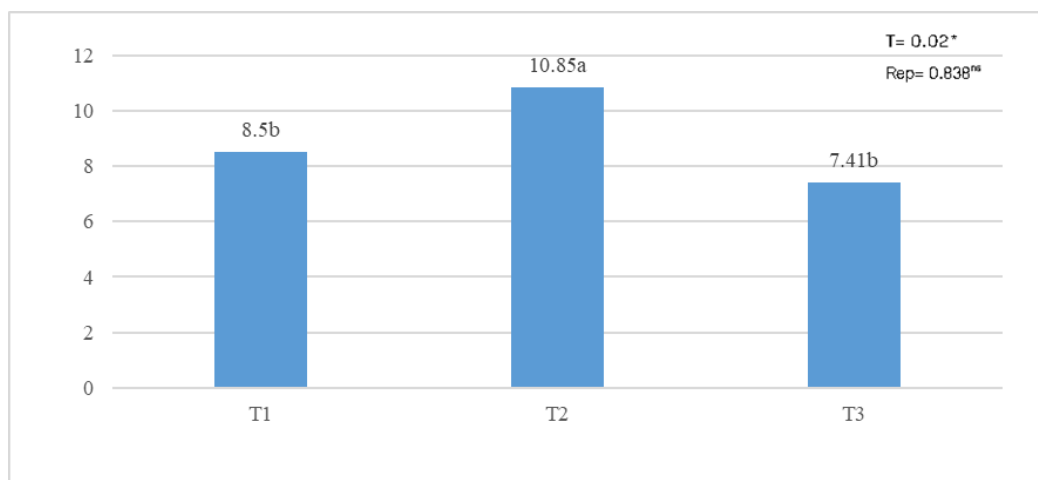


Figure 5. Leaf length of Bak Choy at growing stage (cm)

The results of this figure showed that the leaf length of Bak Choy at growing stage from three treatments differs statistically at a level of 95% reliability (sig. 0.02**). The results show that the second treatment (T2) has a high leaf length of 10.88 cm; and the first (T1) and third (T3) treatments have a similar leaf length of 8.5 cm for T1 and of 7.41 cm for T3. The results show that the highest treatment at growing stage of Bak Choy is the second treatment, while the first and third treatments are non-significantly different.

Leaf length of Bak Choy at harvesting stage (cm)

According to the ANOVA table, the leaf length of Bak Choy at harvesting stage showed that the Pro/Sig value of the treatment equal to 0.000** is to accept H1 (alternate hypothesis) by rejecting H0 (null hypothesis). This means that the three treatments are statistically different at a percentage of 99% confidence in the leaf width of 0.000<0.05. This result showed that the use of different mixtures of topsoil and manure varies the plant leaf length.

Table 6. Leaf length of Bak Choy at harvesting stage (cm)

SV	d.f.	SS	MS	F value	p
Treatment	2	47.77	23.88	36.04	0.000**
Replication	3	1.06	0.35	0.53	0.674s
Error	6	3.97	0.66	-	-
Total	11	-	-	-	-

CV =18.07%

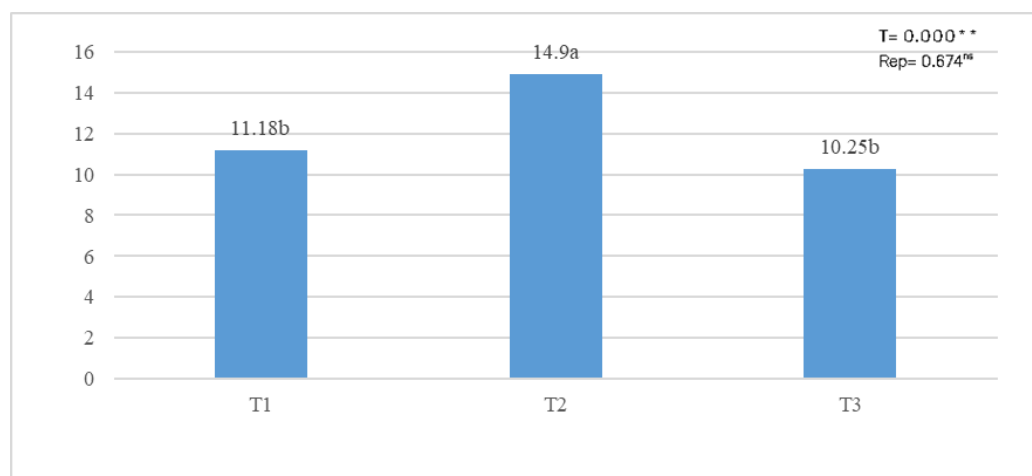


Figure 6. Leaf length of Bak Choy at harvesting stage (cm)

The results of this figure showed that the leaf length of Bak Choy at harvesting stage from three treatments differs statistically at a level of 99% reliability (sig. 0.000**). The results show that the second treatment (T2) has a high leaf length of 14.90 cm; and the first (T1) and third (T3) treatments have a similar leaf length of 11.18 cm for T1 and of 10.29 cm for T3. The results show that the highest treatment at harvesting stage of Bak Choy is the second treatment, while the first and third treatments are non-significantly different. Therefore, farmers should choose to grow Bak Choy using a soil mixture mixed with chicken manure to get a good leaf length, which helps to increase the yield of Bak Choy.

Number of leaves per cluster at growing stage

According to the ANOVA table, the number of leaves per cluster of Bak Choy at growing stage showed that the Pro/Sig value of the treatment equal to 0.01* is to accept H1 (alternate hypothesis) by rejecting H0 (null hypothesis). This means that the three treatments are statistically different at a percentage of 95% confidence in the number of leaves per cluster of 0.01<0.05. This result showed that the use of different mixtures of topsoil and manure varies the number of leaves per cluster of Bak Choy.

Table 7. Number of leaves per cluster at growing stage

SV	d.f.	SS	MS	F value	p
Treatment	2	8.00	4.00	9.00	0.01*
Replication	3	0.33	0.11	0.25	0.859ns
Error	6	2.66	0.44	-	-
Total	11	-	-	-	-

CV =15.38%

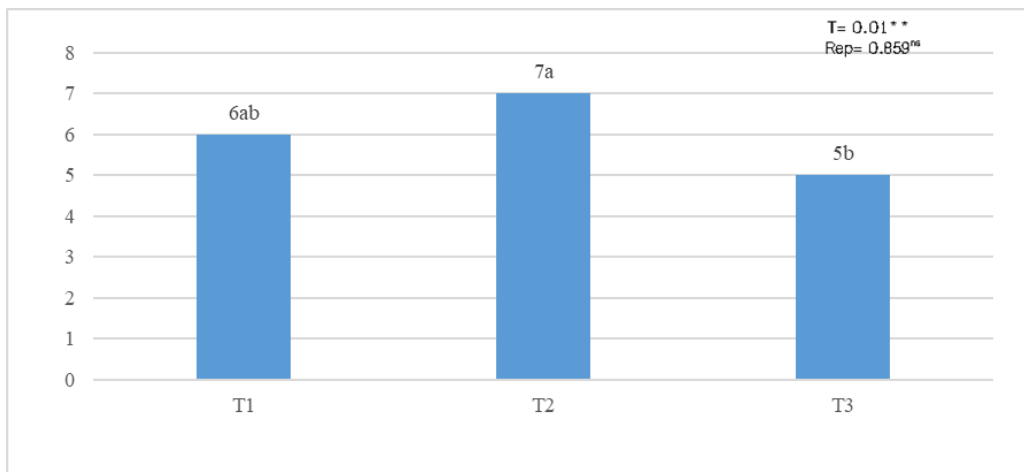


Figure 7. Number of leaves per cluster at growing stage

The results of this figure showed that the number of leaves per cluster at growing stage of Bak Choy from three treatments differs statistically at a level of 95% reliability (sig. 0.01*). The results show that the second treatment (T2) and the first treatment (T1) have a high number of leaves per cluster of 7 leaves and 6 leaves, accordingly. The third (T3) treatment has a smaller number of leaves per cluster of 5 leaves. The results show that the highest treatment at growing stage of Bak Choy is the second treatment (7 leaves per cluster), therefore, the use of a soil mixture mixed with cow dung or chicken manure increases the number of leaves during the growing stage.

Number of leaves per cluster at harvesting stage

According to the ANOVA table, the number of leaves per cluster of Bak Choy at harvesting stage showed that the Pro/Sig value of the treatment equal to 0.001** is to accept H1 (alternate hypothesis) by rejecting H0 (null hypothesis). This means that the three treatments are statistically different at a percentage of 99% confidence in the number of leaves per cluster of 0.001<0.05. This result showed that the use of different mixtures of topsoil and manure varies the number of leaves per cluster of Bak Choy.

Table 8. Number of leaves per cluster at harvesting stage

SV	d.f.	SS	MS	F value	p
Treatment	2	19.50	9.75	23.40	0.001**
Replication	3	0.25	0.08	0.20	0.893ns
Error	6	2.50	0.41	-	-
Total	11	-	-	-	-

CV =15.38%

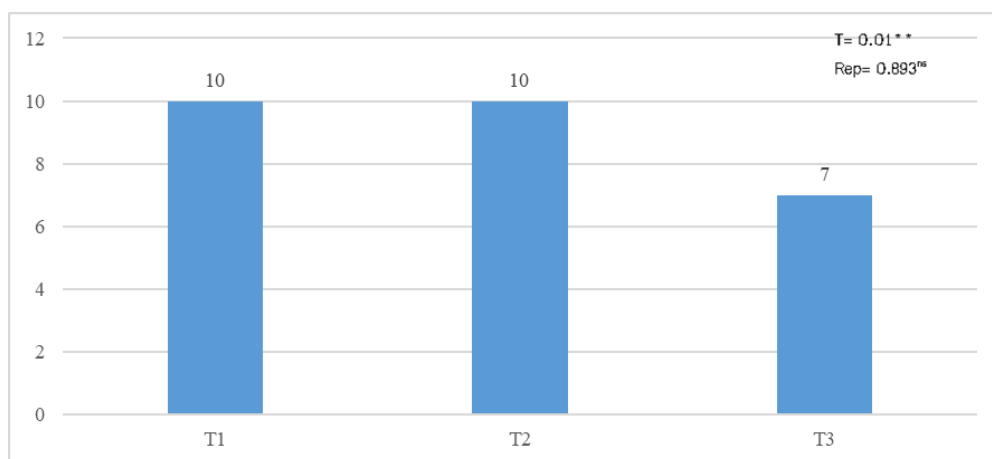


Figure 8. Number of leaves per cluster at harvesting stage

The results of this figure showed that the number of leaves per cluster at harvesting stage of Bak Choy from three treatments differs statistically at a level of 99% reliability (sig. 0.001**). The results show that the second treatment (T2) and the first treatment (T1) have a high number of leaves per cluster of 10 leaves and the third (T3) treatment has a smaller number of leaves per cluster of 7 leaves. The results show that the highest treatments at harvesting stage of Bak Choy are the first and second treatments (10 leaves per cluster), therefore, farmers should choose to cultivate Bak Choy using a soil mixture mixed with chicken manure or a soil mixture mixed with cow dung to get a large number of leaves per cluster. Farmers can choose to use any of the above soil mixes which is easy to find and spend less money and earn much income in the family.

Yield of Bak Choy at harvesting stage (t/ha)

According to the ANOVA table, the yield of Bak Choy at harvesting stage showed that the Pro/Sig value of the treatment equal to 0.000** is to accept H1 (alternate hypothesis) by rejecting H0 (null hypothesis). This means that the three treatments are statistically different at a percentage of 99% confidence in the yield of Bak Choy of 0.000 < 0.05. This result showed that the use of different mixtures of topsoil and manure varies the yield of Bak Choy.

Table 9. Yield of Bak Choy at harvesting stage (t/ha)

SV	d.f.	SS	MS	F value	p
Treatment	2	102.34	51.17	99.31	0.000**
Replication	3	3.18	1.06	2.05	0.207ns
Error	6	3.08	0.51	-	-
Total	11	-	-	-	-

CV = 20.42%

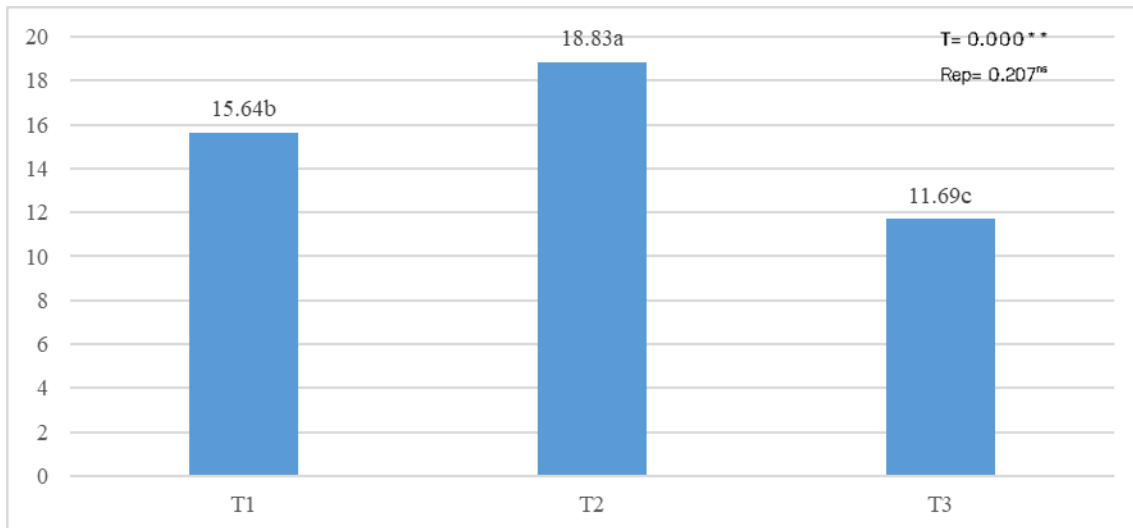


Figure 9. Yield of Bak Choy at harvesting stage (t/ha)

The results of this figure showed that the yield of Bak Choy at harvesting stage from three treatments differs statistically at a level of 99% reliability (sig. 0.000**). The results show that the second treatment (T2) has a high number of yields of 18.83 t/ha, the first treatment (T1) has yielded of 15.64 t/ha and the third treatment (T3) has yielded of 11.69 t/ha. This result confirms that the second treatment has the highest yield, which farmers can apply to the use of soil mix with chicken manure to increase the yield of Bak Choy, to promote the economic benefits, and to reduce the use of chemical fertilizers.

Income and profit from selling Bak Choy (Riel)

The income from the production of Bak Choy is from the sale after the total harvest, and the selling price of the yield depends on market demand, which traders come to buy at 3,500 Riel/Kg.

Table 10. Income from selling Bak Choy (Riel)

No	Treatment	Unit	Yield (t/ha)	Price (Riel/Kg)	Total income (Riel)
1	T1	Kg	17.75	3,500	62,125,000
2	T2	Kg	20.34	3,500	71,190,000
3	T3	Kg	11.97	3,500	41,895,000

For the analysis of profit on Bak Choy, it is obtained from the calculation between the total income and the total cost of each treatment from the sale of Bak Choy.

Table 11. Profit from selling Bak Choy (Riel)

Treatment	Net income (Riel)	Total cost (Riel)	Net profit (Riel)
T1	62,125,000	7,276,200	54,848,800
T2	71,190,000	10,966,200	60,213,800
T3	41,895,000	6,906,200	34,988,800

4. CONCLUSIONS

Through the result of the experiment, it can be concluded that the cultivation of Bak Choy using a soil mixture mixed with different manure actually made the different height of the plant in the growing stage. The second treatment using a soil mixture mixed with chicken manure was the highest height of Bak Choy at growing stage as same as at harvesting stage. Other variables, such as leaf width, leaf length, and the number of leaves per clump, are resulted the same, with treatments that use soil mixture mixed with chicken manure. Yield obtained from experiments using soil mixtures mixed with cow dung, soil mixed with chicken manure, and soil mixed with pig manure is different in the three treatments, and the highest yields is the second treatment. The use of a soil mixture mixed with chicken manure yielded 20.34 t/ha. Based on the results of this study, we can recommend that farmers can use of soil mix with chicken manure to increase the yield of Bak Choy, to promote the economic benefits, and to reduce the use of chemical fertilizers.

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