EFFECT OF MANURE OF DUCKS FED WITH BANANA STEM (*MUSA SAPIENTUM L*) SILAGED ON YIELD AND CHEMICAL COMPOSITION OF WATER SPINACH (*IPOMOEA AQUATICA*)

Dao Thi My Tien

Lecturer at Faculty of Agriculture-TNTN, An Giang University,
Vietnam National University, Ho Chi Minh City

Corresponding author: Dao Thi My Tien. Tel: 0907 681 852; Email: dtmtien@agu.edu.vn

ABSTRACT

One experiment was conducted with 3 treatments and 5 repetitions in a completely randomized design. The treatments including TM1: NPK fertilizers; TM2: manure of ducks fed with *silaged* banana stem (BM); TM3: manure fed with banana stem, molasses and wort (BM-W). The objective was to evaluate the yield of water spinach when applying duck manure fed with banana stem, molasses and wort in replacing the use of NPK fertilizers.

Results showed that:in day 28 TM1 had water spinach height of 38.0 cm, which was 34.7cm higher than that of TM2 but 42.04cm lower than TM3's, the number of leaves in TM1, TM2 and TM3 was 9.26, 8.86 and 8.98 leaves, the leaf length of TM1, TM2 and TM3 was 12.08cm, 10.06cm and 10.97cm, leaf width in TM1, TM2 and TM3 was 1.79cm; 1.15cm and 1.23cm,and the difference between TM1 and TM2 and TM3 was 0.64cm and 0.56cm, respectively. Harvested yield at day 28 after sowing, The treatment 1 (TM1) had an average yield of 702g, which was higher than that of TM2 being 570g, but lower than that of TM3 being 758g. Dry matter content of water spinach in treatment 1 was 5,88%; TM2 was 7.56% and TM3 was 7.43%. The CP TM3 content was 29.83% higher than that of TM1 27.52% and TM2 26.38%.

It can be concluded that manure of ducks fed a fermented diet of banana stem mixed with molasses and wort can be used to fertilize water spinach.

Keywords: *Water spinach, silage, wort.*

INTRODUCTION

Water spinach is a very popular vegetable in Vietnam which can beeasily found all over the country. Water spinach is a common and favored vegetable, not only among human but also among cattle, poultry, especially waterfowl. (Nguyen Manh Chinh and Pham Anh Cuong, 2009).

Chemical or inorganic fertilizers are chemicals containing essential nutrients for plants to be composted into main crops to increase yield. There are types of chemical fertilizers: nitrogen fertilizers (N), phosphorus fertilizers (P), potassium fertilizer (K), complex fertilizer, mixed fertilizer, trace elements fertilizers. However, they are also the cause for plants to thrive quickly but not maintain their effectiveness for a long time.

In addition, they also leave residues in the form of salts in the soil, causing consequences such as preventing plants from absorbing necessary nutrients; destroying beneficial microorganisms which is necessary for plants. Chemical fertilizers can be dangerous and toxic to humans and the environment. Moreover, chemical fertilizers also contain some heavy metals which can accumulate in the soil and contaminateit, and when absorbed by plants, it also accumulates in the product. People and cattle using products containing these metals for a long time will be poisoned (Vo Minh Kha, 2003).

According to Nguyen Xuan Cuong, 2018, the long-term use of chemical fertilizers has polluted, degraded soil and even adversely affected the quality of agricultural products. Promoting clean agricultural production in a sustainable and effective way with the use of

organic fertilizers is an inevitable trend. Thus, organic fertilizer (an organic compound used in agriculture, formed from human excrement, animal manure, leaves and twigs, peat, or other organic waste from the kitchen) which replaces chemical fertilizer is one of the issues that deserves attention in order to solve the harmful effects of chemical fertilizers on plants, soil as well as human health.

According to Tong Xuan Chinh, 2015. We produce about 82 million tons of solid waste and over 60 million tons of liquid waste from livestock every year.

Therefore, the topic "Effect of duck manure fed with silaged banana stem (*Musa sapientum* L) molasses and wort on yield and nutritional composition of water spinach (*Ipomoea aquatica*)" was conducted.

The objective aims at evaluating the yield of water spinach when applying duck manure fed with banana stem, molasses and wort in replacing the use of NPK fertilizers.

MATERIALS AND METHODS

Time and location

Experimental period: from January 2019 to March 2019

The experiment was doneat Trung Thanh Hamlet, My Thoi Ward, Long Xuyen City, An Giang Province.

Materials and experimental design

Experimental treatment

Treatment 1 (TM1): using NPK fertilizer (NPK) (16-16-8-Camau fertilizer)

Treatment 2 (TM2): using duck manure fed with silage banana stemand molasses (BM)

Treatment 3 (TM3): using duck manure fed with banana stem, molasses and wort (BM-W)

Experimental method

The experiment was arranged in a completely randomized design with 3 treatments and 5 replicates. Each replicate was a plastic basket with dimensions (35cm x 45cm). There are 15 baskets of 3 treatments in total.

Methods

Preparations

Cry and crushed soil (1 – 1,5 cm);

Dry straw;

Plastic baskets lined with freight nets;

Seeds: seeds are incubated in warm water for 24 hours.

Performing experiments

Putting soil into plastic baskets with equal amount of soil;

Seeds are sown evenly for each basket of 12 grams, then covered with a thin layer of straw to reduce direct sunlight as well as limit grass growth;

Watering water spinachtwice a day at 6:30 and 16:30, each watering time is 300 ml for each basket;

How to fertilize: once every 4 days, the amount of fertilizer is 120kg/ha(Fresh manure, respectively for each treatment)

After 28 days, harvest with 6 times of fertilizing.

Method of collecting samples

Tracking criteria

Plant height and number of leaves: measure the length of the plant from the base to the highest leaf, start measuring when the plant is 4 days after sowing, then measure once every 4 days, countingthe number of leaves when measuring.

Leaf length and leaf width: measured at 16 days

Freshyield: Harvest at 28 days old

Dry yield and protein content of water spinach

Chemical composition analysis method

Nutritional composition of water spinach was determined by the content of VCK (DM), crude protein (CP) according to AOAC (1990).

Method of data analysing

The collected data are preliminarily processed and stored in EXCEL spreadsheets, then the data are calculated and statistically analyzed to compare the differences between treatments, with 95% reliability, at the P level <0.05 isstatistically significant by using MINITAB software, version 17.

RESULTS AND DISCUSSION

Water spinach height

Height does affect on the growth and development of water spinach. If the plant is tall, the ability to receive light is good, and it enhances metabolism to provide higher yield. The results of plant height are shown in Table 1 .

Table 1. Height of water spinachover the days (cm)

Treatments	The height of water spinach (cm)						
	4 d	***8 d***	***12 d***	***16 d***	***20 d***	***24 d***	***28 d***
TM1	7.18[a]	11.52	21.81 [a]	27.32[a]	32.15[a]	36.71[a]	37.99[b]
TM2	6.16[b]	11.37	19.37[b]	24.05[c]	26.95[c]	30.53[b]	34.72[c]
TM3	5.86 [b]	11.26	19.25 [b]	**26.05 [b]**	**29.71 [b]**	**35.47 [a]**	**42.04 [a]**
SE	**0.11**	**0.17**	**0.30**	**0.33**	**0.47**	**0.63**	**0.78**
P	**0.01**	**0.54**	**0.01**	**0.01**	**0.01**	**0.01**	**0.01**

Note: TM1: using NPK fertilizer; TM2:usingduck manure (BM); TM3:usingduck manure(BM-W).

[a,b]Data in the same column sharing at least one symbol are not significantly different at P<0.05.

The survey results recorded in Table 1 showed that there was a statistically significant difference (P<0.05) in height between the three treatments at the period from 12 to 28 days after sowing. There was no statistical difference at the stage 8 days after sowing(P>0.05), because at this stage, water spinach only used nutrients inside the seeds and partly from the soil, so the height of the plants was still not much different between treatments.

According to the results in Table 1, the stage from 12-24 days after sowing, the plant height in 3 treatments had a statistically significant difference at (P<0.05). The water spinach height in treatment 1(TM1) was higherthan that of the treatment 2 (TM2) and treatment 3 (TM3). Typical for the period at 12 days after sowing, TM1 had a tree height of 21.81 cm, 19.37 cm higher than that of TM2 and 19.25 cm of plant height in TM3. Because TM1 is the treatment using NPK fertilizer, sothe dissolution of fertilizer in the soil is faster than that of TM2 and TM3 treatments being manure, so it takes time to decompose nutrients, therefore, the plantsin TM2 and treatment 3 grown slower and being lower in height. However, at the stage of 24 days after sowing, although there was a difference in plant height among the treatments, there was no difference between TM1 and TM3, thus duck manure provided nutrients to the soil for water spinach to grow and develop.

At the stage of 28 days after sowing, there was significantly different in the height (P < 0.05) among the treatments, TM1had a height of 37.99 cm, higher than that of thetreatment2 being 34.72 cm, but lower than that in the treatment3 being 35.47 cm. The explanation could be plant roots having developed and absorbed the mineral nutrients contained in duck manure for the TM2 and treatment 3.

Thenumber of leaves

In addition to the height, the number of leaves is also an element affecting the growth and yield of water spinach. Because leafisan organ that has the functions of photosynthesis, and respiration. Water spinach has more leaves so that the photosynthetic capacity is better, thereby creating more organic compounds and increasing the plant yield. The more leaves in water spinach has the more help it brings to its parts such as stems, roots, and makes them grow better in comparison with plants that have less leaves. The results are presented in Table 2 .

Table 2. The number of leaves over days

Treatments	**Number of leaves over days**						
	4 d	**8 d**	**12 d**	**16 d**	**20 d**	**24 d**	**28 d**
TM1	2,00	3,00	5,00[a]	6,00[a]	6,86	8,13[a]	9,26
TM2	2,00	3,00	4,43[b]	5,80[ab]	7,81	7,48[b]	8,86
TM3	2,00	3,00	4,38 [b]	**5,77 [b]**	**6,75**	**8,08 [a]**	**8,98**
SE	**0,00**	**0,00**	**0,05**	**0,06**	**0,68**	**0,11**	**0,14**
P	**-**	**-**	**0,01**	**0,02**	**0,48**	**0,01**	**0,13**

Note: TM1: using NPK fertilizer; TM2: usingduck manure (BM); TM3: usingduck manure(BM-W).

[a,b]Data in the same column sharing at least one symbol are not significantly different at P<0.05.

The results recorded in Table 2 shows that, at the stage from 4 to 8 days after sowing, the number of leaves of all three treatments was the same. The reason is that at the stage of 4 days after sowing, all three treatments had only epicotyls, up to 8 days after sowing, in all three treatments, only a few plants had leaves, so there was no difference. At the stage of 4 - 8 days after sowing, because the roots were not fully developed to absorb nutrients from the manure, the growth of the number of leaves did not show any difference between the treatments.

In the stage from 12-16 days after sowing and 24 days after sowing, it was found that there was a statistically significant difference ($P<0.05$) between the three treatments. At this stage, TM1 ha a higher number of leaves than TM2 and TM3. 16 days after sowing, the number of leaves in TM1 was 6.00, the number of leaves in TM2 and TM3 was 5.80 leaves and 5.77 leaves respectively. At the stage of 20 days after sowing, the number of leaves was not significantly different among the treatments ($P>0.05$). Because at this stage, the roots of water spinach developed, and the absorption of nutrients was stronger than in the previous stage. At the stage of 24 - 28 days after sowing, the NPK fertilizer in TM1 has been resolved with more nutrients of the fertilizer, so the number of leaves in TM1 was more than TM2 and treatment 3, however there was no difference between TM1 and treatment 3. This lasted until stage 28 days after sowing, and number of leaves treatment was 9.26, 8.86 and 9,26 for the TM1, TM2 and TM3, respectively.

Leaf length

Leaf length has a very important effectin the growth of water spinach. It's also a factor affecting photosynthesis, yield and crops quality. The leaf length results are presented in Table 3.

Table 3. Leaf length of water spinach over days (cm)

Treatment	**Leaf length of water spinach (cm) over days**			
	16d	***20d***	***24d***	***28d***
TM1	8.57^{a}	9.84^{a}	10.69^{a}	12.08^{a}
TM2	7.41^{b}	8.44^{b}	9.24^{b}	10.06^{c}
TM3	7.67^{b}	8.84^{b}	9.79^{b}	10.97^{b}
SE	**0.19**	**0.18**	**0.18**	**0.19**
P	**0.01**	**0.01**	**0.01**	**0.01**

Note: TM1: using NPK fertilizer; TM2: usingduck manure (BM); TM3: usingduck manure(BM-W).

^{a,b}Data in the same column sharing at least one symbol are not significantly different at $P<0.05$.

The results recorded in Table 3 showed that the leaf lengths of the three treatments over the stage from 16 to 28 days after sowing had a statistically significant difference ($P<0.05$). It is

possible that at this stage the roots have developed, so the absorption of nutrients is stronger than in the previous stage.

In stage 4 days after sowing the plant has not yet formed leaves; In stage 8 days after sowing, some true-leaved plants have just appeared, so the indicator cannot be measured at this stage.

In all stages from 16 to 28 days after sowing, leaf length in TM1 was higher than that in TM2 and TM3; 16 days after sowing, leaf length in TM1 is 8.57cm, difference compared with TM2 (7.41 cm) was 1.16 cm and difference compared with TM3 (7.67 cm) is 0.90 cm; to stage 28 days after sowing leaf length in TM1 was 12.08 cm, the difference compared with TM2 (10.06 cm) was 2.02 cm and the difference compared with TM3 (10.97 cm) was 1.11 cm. Because TM1 uses NPK fertilizer with high mineral nutrient content, the roots can easily absorb and transport to parts of the plant and to the leaves, so the leaves in TM1 have a longer leaf length than in TM2 and TM3.

Leafwidth

Leaf width plays an important role as well as leaf length, the wider the leaves of water spinach, the more light they can absorb for photosynthesis to produce more starch, increase plant weight, thereby increasing yield and income. The leaf width results are presented in Table 4.

Table 4. Leaf width of water spinach over days (cm)

Treatments	**Leaf width of water spinach (cm)**			
	16d	***20d***	***24d***	***28d***
TM1	1.10[a]	1.30[a]	1.47[a]	1.79[a]
TM2	0.78[b]	0.92[b]	1.02[c]	1.15[b]
TM3	0.82[b]	0.98[b]	**1.12[b]**	1.23[b]
SE	**0.03**	**0.02**	**0.02**	**0.03**
P	**0.01**	**0.01**	**0.01**	**0.01**

Note: TM1: using NPK fertilizer; TM2: usingduck manure (BM); TM3: usingduck manure(BM-W).

[a,b]Data in the same column sharing at least one symbol are not significantly different at P<0.05.

In Table 4, there was a statistically significant difference (P<0.05) of the leaf width among three treatments over the stage from 16 to 28 days after sowing. At this stage, the roots have also developed, so the absorption of nutrients is stronger than in the previous stage, just like the length of leaves, at the 4 days after sowing stage, the plant has not yet formed realleaves; In stage 8 days after sowing, some real leaves have just appeared, so this indicator is not measured.

In all stages, leaf width in TM2 and TM3 was shorter than that in treatment 1; 16 days after sowing, leaf width reached 1.10 cm in TM1 and 0.78 cm in treatment 2 withthe difference of 0.32 cm, and 0.28 cm compared with treatment 3; in stage 28 days after sowing, the leaf width of TM1, TM2 and treatment 3 was 1.79 cm, 1.15 cm and 1.23 cm respectively. Because TM1 uses NPK fertilizer with high mineral nutrient content, the roots could easily absorb and transport to other parts of the plant and to the leaves, so the leave width in TM1 was wider than that of in TM2 and treatment 3.

Harvest yield, dry matter content and protein content

The average plant weight is high or low depending on the heritability of the variety as the first factor. In addition, it also depends on care, nutrition and external conditions. the fresh yield, dry matter and protein content are presented in Table 5.

Table 5. Harvest yield, dry matter and protein content of water spinach

Treatment	Harvest yield, dry matter and protein content		
	Fresh yield (g/m^2)	***Dry matter (%)***	***CP(%DM)***
TM1	702	5.88	27.52
TM2	568	7.56	26.38
TM3	**758**	7.43	**29.83**
SE	**0.05**	**0.78**	**0.32**
P	**0.08**	**0.25**	**0.75**

Note: TM1: using NPK fertilizer; TM2: usingduck manure (BM); TM3: usingduck manure(BM-W).

According to the results of Table 5, the average plant yield of TM1 is 702 g, which is higher than the average plant yield of TM2 of 570 g but lower than that of TM3 of 758 g, due to the difference in plant fertilizer composition between NPK and duck manure which were fed with banana stem mixed with molasses and supplemented with wort as well as the health status of ducks when fertilizing. However, this difference was not statistically significant (P>0.05).

According to the results of Table 5, there is no statistically significant difference in dry matter content (P > 0.05) among the treatments. The dry matter content of water spinach in TM1, TM2 and treatment 3 was 5.88%, 7.56% and 7.43%, respectively.

Because treatment 1 used NPK fertilizer, the plants grew quickly, the plants stored a lot of water, the average yield of plants in treatment 1 was heavier than the average yield of plants of treatment 2 and treatment 3, but because the plants stored a lot of water, so that when drying, more water was lost, thus leading to lower dry matter in treatment 1 than in treatment 2 and 3. Therefore, the protein composition of treatment 3 (29.83%) was higher than that of treatment 1 (27.52%). Because the nutrients contained in duck manure were effective, treatment 3 had taller and larger stems at 28 days after sowing, so the yield in treatment 3 was higher than that of treatment 1.

Table 6. Economic efficiency (VND/m^2)

Item	Treatment		
	TM1	***TM2***	***TM3***
Material cost	6.000	4.519	4.519
Labor cost	300	300	300
Total	**6.300**	4.819	4.819
Fresh yield (g/m^2)	702	568	**758**
Price (VND/g)	10	10	10
Total revenue	7.020	5.700	**7.580**
Difference (VND/m^2)	720	**881**	**2.761**

Note: TM1: using NPK fertilizer; TM2: using duck manure (BM); TM3: using duck manure (BM-W).

Table 6 shows that the investment cost in TM1 is 6,300 VND/m2, higher than the investment cost of TM2 and TM3 (4,819 VND/m2), so the profit earned in TM1 is 720 VND/m2, lower than TM2 (881 VND/m2) and TM3 (2,761 VND/m2). This means that the cultivation of water spinach using duck manure fed with banana stem, molasses and wort brings higher profits than the use of NPK fertilizers.

CONCLUSIONS

From the analysis results of the 3 treatments, it is allowed to conclude:

It is possible to use duck manure fed with banana stem, molasses and wort to completely replace the application of inorganic fertilizer (NPK) for water spinach.

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