ผลของปุ๋ยอินทรีย์ต่อการเจริญเติบโตและผลผลิตของหญ้าแพงโกล่า (*Digitaria eriantha*) ในช่วงฤดูแล้ง

Effect of Organic Fertilizer on the Growth and Yield of Pangola (*Digitaria eriantha*) during the Dry Season

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บทคัดย่อ

แปลงหญ้าเป็นสิ่งสำคัญสำหรับเกษตรกรเลี้ยงสัตว์โดยเฉพาะอย่างยิ่งในช่วงฤดูแล้งเมื่อการขาดแคลนอาหารเกิดขึ้นและการจัดการคุณภาพอาหารไม่ดี อย่างไรก็ตามผลผลิตสามารถเพิ่มขึ้นและค่าใช้จ่ายที่เกี่ยวข้องกับปุ๋ยเคมีลดลงผ่านการใช้ปุ๋ยอินทรีย์ราคาไม่แพง การศึกษาครั้งนี้มีวัตถุประสงค์เพื่อศึกษาอัตราการตอบสนองของปุ๋ยอินทรีย์สำหรับปลูกหญ้าแพงโกล่า (*Digitaria eriantha*) ต่อคุณภาพผลผลิตและคุณภาพดินหลังปลูกช่วงฤดูแล้งในประเทศไทยโดยมีอุณหภูมิเฉลี่ยอยู่ที่ 29.8 ± 1.1 องศาเซลเซียส และความชื้นเฉลี่ย 75.0 ± 7.6% วางแผนการทดลองใช้แบบ Randomized Complete Block Design (RCBD) โดยแบ่งเป็น 3 กลุ่ม กลุ่มที่ได้รับ 1 สูตร คือสูตรที่ 1 (สูตรควบคุม) สูตร 2 (ปุ๋ยอินทรีย์จากร้านค้าปุ๋ย) สูตรที่ 3 (มูลสุกร มูลไก่ และดิน อัตราส่วน 1: 1: 1) และสูตรที่ 4 (มูลสุกร, มูลไก่ และดิน (อัตราส่วน 1.5: 1.5: 0) ผลการทดลองพบว่า อัตราการตอบสนองของสูตรปุ๋ยอินทรีย์สำหรับหญ้าแพงโกล่า (*Digitaria eriantha*) สูตร 4 (อัตราส่วน 1.5: 1.5: 0) มีสมรรถนะต่อการผลิตที่ 0-15 วันสูงกว่าสูตร 1, 2 และ 3 อย่างมีนัยสำคัญทางสถิติ ($P < 0.05$) สูตรที่ 3 (อัตราส่วน 1: 1: 1) ทำให้หญ้าแพงโกล่ามีความสูงกว่าสูตร 1 สูตร 2 และสูตร 4 แตกต่างกันอย่างมีนัยสำคัญทางสถิติ ($P<0.05$) และจำนวนหน่อต่อกอ อยู่ระหว่าง 0-15 และ 30-45 ของการใช้สูตรที่ 2 และ 3 ช่วยเพิ่มจำนวนหน่อต่อกอมากกว่า สูตร 1 และสูตร 4 แตกต่างอย่างมีนัยสำคัญทางสถิติ ($P <0.05$) สำหรับองค์ประกอบทางเคมีของหญ้าทนแล้งสูตร 4 มีความชื้นและโปรตีนสูงกว่าเถ้าไขมันและเส้นใยและแตกต่างกันอย่างมีนัยสำคัญทางสถิติ ($P<0.05$) ปริมาณโพแทสเซียมและแคลเซียมในดินทุกวิธีมีค่าเพิ่มขึ้น และค่าความเป็นกรด – ด่างลดลง

คำสำคัญ : ปุ๋ยอินทรีย์ การเจริญเติบโตและผลผลิต หญ้าแพงโกล่า (*Digitaria eriantha*) ฤดูแล้ง

Abstract

Pasture is important for farmers, especially during the dry season, when food shortages occur and food quality management is poor. However, productivity can be increased and the costs associated with chemical fertilizers lowered via the use of inexpensive organic fertilizers. The objective of this study was to investigate the effect of organic fertilizer on the growth and yield of Pangola (*Digitaria eriantha*) during the dry season. During the experiment, the average temperature was 29.8 ± 1.1°C, and the average humidity was 75.0 ± 7.6%. A randomized complete block design (RCBD) was implemented, with the study site divided into 3 grass plots. Each plot of grass received all formulas, with formula 3 composed of fertilizer, chicken manure and soil in a 1:1:1 ratio and formula 4 composed of pig manure, chicken manure and soil in a 1.5:1.5:0 ratio. The results showed that the effect of organic fertilizer on Pangola (*Digitaria eriantha*) during the dry season in Thailand using formula 1 (1.5:1.5:0) was significantly ($P<0.05$) higher at 0-15 days compared with that of formulas 2 and 3.The number of shoots per clump from 0-15 days and 30-45 days of treatments was significantly higher for formula 3 (1:1:1) than formulas 1, 2 and 4 ($P<0.05$). The number of shoots

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per clump was significantly higher under formulas 2 and 3 than formulas 1 and 4 (P<0.05). The chemical composition of the drought-tolerant grass under formula 4 was significantly higher in moisture and protein content than ash, fat and fiber content, and these results were significantly different from the other treatments (P<0.05). Moreover, the potassium and calcium content in all soils were significantly increased, and the pH values were decreased.

Keywords : Organic Fertilizer, Growth and Yield, Pangola (*Digitaria eriantha*), Dry season

Introduction

Feed production is particularly important for animal feed management, which is implemented to ensure that animal feed is of sufficient quality and suitable for animal production. Therefore, farmers should consider cultivation practices that can compensate for or replace and reduce the roughage costs during the dry season.[1] Feedstuffs and other materials can now be used for livestock in each season, which is important for the production of livestock farmers. [5,8] The quantity and quality of food are important factors for increasing the productivity of ruminants.[4,14] The nutritional requirements of ruminants vary according to the amount of energy that animals use in their activities associated with living, growing and producing. Therefore, diets that provide nutrients to ruminants are important and primarily focused on energy and protein. However, the dry season in Thailand is a difficult time period because of the reductions in the quantity and quality of food. [23,25] The cultivation of Pangola grass (*Digitaria eriantha*) has been studied in all seasons in Thailand. [24,32] Pangola grass (*Digitaria eriantha*) is very fragrant and suitable for use as a rough feed for ruminants because it includes 29% fiber, 8.2% ash and 46% carbohydrates. The total digestible nutrients (TDNs) in pet feed are 59%, with 23% ADF at 35.7%, NDF at 63.3%, Ca at 0.44% and P at 0.3%.[2,23] The Department of Livestock Development in Thailand has introduced and encouraged farmers to grow Pangola (*Digitaria eriantha*). This grass is soft and has small flesh; thus, it is easily digested and utilized by ruminants. The general characteristics of this grass are numerous. [31,26] After many years, this grass can grow in many types of soil and is more resistant to flooding than other grasses.[1,10] This grass can grow in lowland areas and meadows, which can be utilized for the release of animals to feed and are suitable for grass-fed production. Pangola grass (*Digitaria eriantha*) is suitable in flood-prone areas for many years. [23,17] Animals find this grass palatable; thus, the grass is suitable as hay. The grass has trunks along the surface and is spread by using 7-13 sections of 3-8 cm long sections of cracked roots and shoots. For the conversion of grass, farmers generally use chemical fertilizers to increase yields. The long-term use of fertilizers can cause pollution to the soil, water and air, and it results in the increased yield and quality of raw materials due to increased soil acidity. [24,11] Based on information from pastures or pets, the proportion of animals is very low compared to the number of animals. Fertilizers often focus on plant nutrients, such as nitrogen, phosphorus, and potassium. [16,18] The long-term use of chemical fertilizers without soil improvement may degrade the soil until it is unsuitable for crop production via hardening of clay and changes to the soil pH and salinity. Moreover, the long-term use of chemical fertilizers affects the surrounding ecosystems as a result of contaminated soil or water, which leads to impacts on consumers. Using organic fertilizer may represent an option for soil improvement, [9,30] and it can reduce production costs and provide a nutrient source that is beneficial to plants when degraded via microorganisms. [7, 22] Groundnut organic fertilizer is derived from the manure of animals (e.g., ducks, chickens, pigs and cows), [10] and it represents a source of nutrients that can improve the soil, especially during the dry season. [2,36] To increase productivity and reduce costs, organic fertilizers are generally produced locally by using locally sourced raw materials, and these fertilizers may also include different nutrients. [12,15]

The objective of this study was to investigate the effect of organic fertilizer on the yield and quality of Pangola grass (*Digitaria eriantha*) during the dry season in Thailand.

Materials and Methods

The effects of the application of organic fertilizer on the yield of Pangola grass (*Digitaria eriantha*) during the dry season in Thailand from February to May 2017 were studied. The average temperature was 29.8 ± 1.1 °C, and the average humidity was 75.0 ± 7.6%. The effect on the leaf number of Pangola grass (*Digitaria eriantha*) was recorded, and the chemical composition of the grass, such as the moisture, ash, fat, fiber and protein content, was measured.[2,37] Each plot was treated with either formula 1 (control formula), formula 2 (organic fertilizer from the fertilizer store), formula 3 (pig manure, chicken manure and soil in a 1:1:1 ratio) and formula 4 (pig manure, chicken manure and soil in a 1.5:1.5:0 ratio) The results of the nutrient volume analysis for the organic fertilizer indicated that the contents were not significantly different at N = 1.75, P_2O5 = 1.66, and K_2O = 1.01.

Experimental areas. The experimental plot of Pangola (*Digitaria eriantha*) was 6x8 m, and 3 kg / 100 m^3 of fertilizer was applied. At 3 time intervals 0-15, 15-30 and 30-45 days

Data collection: After 45 days of randomization with 10 × 30 cm sieve equipment, random sampling was performed for 10-15 points in each plot, and mowing was performed to obtain data on the growth rates. The number of shoots, height, leaf weight per stem, number of leaves per bouquet, fresh weight, number of shoots per 10 stems, and ratio of shoots to shoots were determined. For each plot, the composition of each formula was assessed to analyze the chemical composition of the grass, with the analyses performed at the animal feed laboratory at Nakhon Sawan Rajabhat University.

Soil samples were collected before and after the organic fertilizer treatments. Before digging the soil, the grass was removed, and any debris was swept away (we did not cut or scrape off the soil) using a drop or shovel. Then, holes were dug at a vertical depth to the level of tillage for all plants (except grass, which is 5 cm deep, and perennials, which is 30 cm). The thickness of the hole was approximately 2-3 cm at the bottom. [29] The clay content was determine by combining the soil in a bucket or plastic container. [1,28]

An analysis of variance was performed using the Statistical Analysis System (SAS) program for randomized complete block design (RCBD), [34] and the mean values were compared using Duncan's new multiple range test. [35] The differences in means were considered significant at P< 0.05.

Results

The effect of organic fertilizer on the yield of Pangola grass (*Digitaria eriantha*) during the dry season in Thailand from February to May 2017 was investigated. The average temperature was 29.8 ± 1.1 °C, and the average humidity was 75.0 ± 7.6%. The results are as follows.

The effect of organic fertilizer on Pangola grass (*Digitaria eriantha*) during the dry season in Thailand showed that the height of Pangola grass (*Digitaria eriantha*) under formula 4 was significantly increased at 0-15 days (P<0.05). At 15-30 days, the height was significantly higher for formula 3 compared with formula 1, formula 2 and formula 4 (P<0.05), although the values of the latter three formulas significantly differed (P>0.05). From days 0-15, 15-30 and 30-45 days, the weight of the grass did not significantly differ (P>0.05), and the number of shoots per clump of Pangola grass (*Digitaria eriantha*). The ratio of organic fertilizer to shoots of Pangola grass (*Digitaria eriantha*) was 0-15 days. Formulas 2 and 3 produced a higher number of shoots than formula 1 and formula 4 (P<0.05). For 15-30 Statistically significant differences (P>0.05) were not observed from days 15-30. Formula 1 and formula 2 were significantly higher than formula 1 and formula 4 (P<0.05). The ratio of organic fertilizer to the leaves of Pangola grass (*Digitaria eriantha*) showed that formulas 1, 2, 3 and 4 did not affect the number of stems per clump, and were not significantly differences (P>0.05), as shown in Table 1.

The effect of organic fertilizer on the chemical composition of Pangola (*Digitaria eriantha*) during the dry season in Thailand was also assessed, and the results showed that the moisture, ash, fat and protein contents were higher under formula 4 (7.27 %CP) compared with formulas 1, 2 and 3; the difference was statistically significant (P <0.05), as shown in Table 2.

The assessment of soil quality showed that the long-term use of chemical fertilizers on grass causes soil deterioration and increases the acidity, while the use of organic fertilizer increases the amount of organic matter and nutrients. The organic matter content in the soil was 1.6%, and the average phosphorus content was 1.8 mg / kg. The average potassium content was 7.66 mg / kg, and the average acid content was 7.56 mg / kg. of soil. Thus, the use of organic fertilizer (i.e., manure) is recommended to increase the efficiency of chemical fertilizer applications. The potassium content in the plant was 17 mg / kg, the calcium content was 654 mg / kg, and the pH was 6.9 in grassland 2, which presented a phosphorus concentration of 1 mg / kg. The average organic matter content was 16% and 732 mg / kg, and the pH was 5.8 in grassland level 3, which presented a phosphorus concentration of 1 mg / kg, an average potassium content of 17 mg / kg, calcium content of 897 mg / kg, and a pH of 6.4. At 16.66 mm; the amount of calcium per kilogram on average was 7.61, and the acid - base average occurred at 6.36 mg / kg. Higher potassium and calcium contents corresponded to lower pH as shown in Table 3.

Table 1 The effect of organic fertilizer on the productive performance of Pangola grass.

Item	Organic fertilizer					SEM	P-value
	Formula 1 Control	Formula 2 Market	Formula 3 (1:1:1)	Formula 4 (1.5:1.5:0)	Ave		
Height (Day)			(cm)				
0-15	39.66^{c}	41.33^{b}	36.00^{c}	43.33^{a}	40.00	1.66	0.04*
15-30	32.33^{b}	31.66^{b}	36.33^{a}	27.33^{c}	31.92	1.51	0.01*
30-45	48.66	54.33	52.00	51.66	51.49	2.49	0.34^{ns}
Ave	40.22	42.44	41.44	40.77			
Weight (Day)			(g)				
0-15	250.00	250.00	216.66	210.00	231.5	23.78	0.75^{ns}
15-30	296.66	313.33	320.00	333.33	315.83	22.98	0.30^{ns}
30-45	343.33	383.33	433.33	380.00	384.99	28.19	0.51^{ns}
Ave	296.66	236.66	323.33	307.77			
Number of shoots per clump (Day)			(shoots)				
0-15	7.80^{b}	10.7^{a}	11.2^{a}	9.50^{b}	9.80	0.761	0.02*
15-30	15.00	15.40	14.60	13.30	14.57	1.06	0.66^{ns}
30-45	13.90^{b}	16.50^{a}	15.20^{a}	14.60^{b}	15.05	1.04	0.01*
Ave	12.23	14.2	13.66	12.46			
Number of trunks per 10 clumps (trunks)	11.70	11.40	9.50	9.90		0.723	0.10^{ns}
Ratio of clump (clump)	9.60	9.80	8.60	9.20		0.719	0.66^{ns}
Leaf per clump (leaf)	32.8	31.4	28.0	24.9		2.13	0.12^{ns}

^{abc}The letters displayed in each row. The difference was statistically significant (P <0.05).

^{ns}= difference (p>0.05) * = significant difference (p <0.05)

Table 2 The effect of organic fertilizer on the chemical composition of Pangola grass.

Item	Organic fertilizer				SEM	P-value
	Formula 1 Control	Formula 2 fertilizer store	Formula 3 (1:1:1)	Formula 4 (1.5:1.5:0)		
Moisture	32.38[b]	29.33[b]	33.04[b]	36.73[a]	0.464	0.01*
Ash	2.75[b]	2.89[b]	3.34[b]	4.29[a]	0.206	0.01*
Fat	1.92[b]	1.09[b]	1.50[b]	2.38[a]	0.561	0.04*
Fibre	37.97[a]	38.85[a]	38.36[a]	36.26[b]	2.15	0.02*
Protein	5.22[b]	5.08[b]	5.75[b]	7.27[a]	0.109	0.01*

[abc]The letters displayed in each row. The difference was statistically significant (P <0.05).

Table 3 Soil sample analysis results before and after the trial.

Grass experiment plot	Mineral				
	Organic matter (%)	Phosphorus (mg / kg)	Potassium (mg / kg)	Calcium (mg / kg)	Acid-base (pH 1:1)
Pre-trial					
1	0.97	3	8	-	6.3
2	1.31	2	9	-	8.5
3	1.70	1	6	-	8.3
Average	1.6	1.8	7.66	-	7.56
After trial					
1	-	1	17	654	6.9
2	-	1	16	732	5.8
3	-	1	17	897	6.4
Average	-	1	16.66	761	6.36

Discussion and Conclusions

The effect of organic fertilizer on the yield and quality of Pangola grass (*Digitaria eriantha*) during the dry season in Thailand was determined by measuring the height, weight, number of shoots, number of leaves and number of leaves per clump. The composition of grass was studied based on a 45-day cutting test. [6,20] The analysis showed that the moisture content, ash, fat, fiber and protein of Pangola (*Digitaria eriantha*) at 45 days under formula 4 (7.27 %CP) were higher than that of the other formulas, and the difference was statistically significant. From 15-30 days, the number of shoots per clump, fresh weight, number of shoots per 10 clumps and number of leaves per clump were not significantly different. The soil quality after planting was assessed, the potassium and calcium contents were higher, and a lower pH was observed.

Various chemical fertilizers have been applied to improve the growth of Pangola grass (*Digitaria eriantha*). The findings of this study showed that Pangola presented a positive response to organic fertilizer in terms of productivity and soil quality when planted at sites located in the drought region in Thailand. The results of the soil nutrient analysis at the end of the experiment showed

that the potassium and calcium content in the soil increased and the pH decreased. Rodchum *et al* (2017) reported that the organic matter (OM), P, K, Ca and N_2O and NH_3 contents were consistent with those found by Kulana *et al*., (2007) reports have indicated that high-quality organic fertilizers only improve the chemical properties of the soil after planting. Organic compounds, nitrogen and phosphorus are beneficial to plants. This study investigated the proportion of organic fertilizer that improved production, and the results obtained using organic fertilizer are consistent with those using chemical fertilizer. Pumparn *et al*., (2017) reported that more than 2,000 kg per rai was required. Therefore, the stem height, leaf number, leaf width, leaf length, and fresh weight of the plantswere tested The dry matter and total yield obtained with. phosphorus fertilizer were higher than those obtained with the chicken manure application. The only fertilizer application was the growth, yield and nutrient absorption. The phosphorus content in rice and corn grown using high-quality organic fertilizer was the same or better compared with that using chemical fertilizer alone. High-quality chemical fertilizers have the potential to improve soil chemical properties via the inclusion of nitrogen and phosphorus and maximizing the ash and protein content. In addition, the chemical composition of organic fertilizer is higher in certain nutrients than chemical fertilizer. (Pholsen, 2007) As the amount of nitrogen and ash content in livestock feedstock increased, only fertilizer was used. The use of chicken manure in drought-tolerant grass reduces the protein content and lowers the chemical composition of the grass compared with the use of urea.[5,19] Organic grass production using organic fertilizers is recommended for the production of organic animal products derived from ruminants, such as buffalo, goat and sheep, to reduce fertilizer costs, provide safe products for consumers and reduce global pollution.[2,9,25]

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