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Effect of Organic and Inorganic Fertilizers on Yield and Quality of *Synedrella nodiflora* (Tropical Weed)

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ABSTRACT

This study aimed to determine the effect of organic and inorganic fertilizers on the cultivation of tropical weed *Synedrella nodiflora* as forage. The study was conducted from May to July 2018. The treatments of the research were control (C), organic fertilizer (D) and organic fertilizer + urea (DU), with 3 replications that were arranged on experimental design with a completely randomized design, in a unidirectional pattern and continued with *least significant different* (LSD). Organic fertilizer dosage in this study was 5 tons/ha, while urea fertilizer was 350 kg/ha, with plant spacing was 45x60 cm. The observed parameters were plant height, forage production and chemical composition (5 weeks after planting). Plant height of C, D and DU were 41.59, 47,42, and 50.59 cm respectively. Forage production of dry matter after 5 weeks planting at C, D and DU were 1.69, 1.70 and 2.91ton/ha, with *in vitro* digestibility values ranging from 51.68 to 57.70% (IVDMD) and 51.71 to 61.98% (OMD) respectively. The chemical composition of native *S. Nodiflora* were 12.32% of dry matter (DM), 62.45% TDN count for cattle and 67.42% TDN count for sheep. Based on DM, The organic matter was 84.46%, crude protein 20,11%, crude fiber 13.26%, extract ether 7.77%, and nitrogen free extract 37.08%. The combination of organic fertilizer and urea increased the height and fresh and dry matter production *S. nodiflora.*

Keywords: Fertilizer, Forage, Organic, *Synedrella nodiflora*, Tropical weed

Introduction

Indonesia is a tropical country with two seasons, rainy and dry season. However, the forages availability is facing problem of stock (quality and quantity) due to climate. Generally, the forage was abundant during the wet season and was deficit during dry season. Livestock, especially ruminants has demanded of forage. Forage as a feed are cheaper compared to concentrate. One effort that can be done to secure the stock (quality and quantity) is looking a forage type for feed that has good ability to grow both in the dry and wet season. Generally, weed was used as forage by farmers as feed for ruminant. It can be obtained from agricultural land. Agricultural weeds have persistent and adaptable characters. One type of weed is *Synedrella nodiflora* with the local name "*legetan*".

Dianita (2014) found that the results of forage *in vitro* analysis were VFA (93.31 mM), NH3 (8.90 mM), dry matter digestibility (33.53%), organic matter digestibility (30.95%) on sheep rumen liquid, while the results of the forage *in vitro* analysis with cattle rumen include the findings of VFA (72.58 mM), NH3 (5.01 mM), dry matter digestibility (32.42%), and organic matter digestibility (29.90%). *In vitro* analysis with cattle rumen liquid has higher results compared with sheep rumen liquid.

One of the tropical forage which can be used as feed which has high crude protein is *Synedrellla nodiflora*. Chemical composition of *Synedrellla nodiflora* according to Bindelle *et al*. (2007) were dry matter (18%), crude protein (20.7%), crude fiber (23%), ash (15.7%), neutral detergent fiber (37.6%), acid detergent fiber (32.5%), and lignin (16.7%). *S. nodlifora* is not widely known even though it grows abundantly and easily propagated in all types of land, and even it has the ability to regrowth.

According to Adjibode *et al*. (2015), *Synedrella nodiflora* is usually eaten by livestock and food for humans due to the absence of toxicity. *Synedrella nodiflora* leaves can be used as a supplier of Gonadotrophin Pregnant Mare Serum in animal husbandry to improve reproductive in heifer. Fresh leaves of *Synedrella nodiflora* as much as 100 g which were used as feed supplements in rabbits improved fertility and

litter size. *Synedrella nodiflora* leaves significantly reduced mortality from birth to weaning in rabbits (Benoit *et al*., 2014). Jerebi and Naandam (2015) found that offering fresh *Synedrella nodiflora* for 49 d did not give negative effects on rabbit hematological parameters. The result of observations of all data was within the normal range for rabbits.

Based on the description above, it is necessary to perform further research related to *Synedrella nodiflora.* It can be used as an alternative feed to support sustainable livestock production systems in tropical countries. Therefore, it is necessary to study *S. nodiflora* cultivation with fertilization included nutritional or anti-nutritional factors that might be appear.

Materials and Methods

The research was carried out from May to June 2018 at the field and 2 months from July to August 2018 at the Laboratory of Forage and Pasture Science, Faculty of Animal Science, Universitas Gadjah Mada.

Research equipments

The equipments needed in this study were a ruler, meter, caliper, ropes, scissors, knives, plastic bags, paper bags, buckets, scales, ovens, stationery and agricultural tools. A set of analytical tools for dry matter and organic matter (AOAC, 2005), a set of two-stage *in vitro* digestibility analysis (Tilley and Terry,1963) also were used.

Research materials

The research material used were *Synedrella nodiflora*, organic fertilizer (feces), inorganic fertilizer (urea), chemicals for two-stage *in vitro* digestibility analysis (Tilley and Terry, 1963).

Research methods

Ane way completely randomized design was used in this study. The treatments were control (without addition of fertilizer) (C), organic fertilizer (D) and organic fertilizer + urea fertilizer (DU), each treatment with 3 replications. Organic and urea fertilizer in this study were 5 tons/ha and 350 kg/ha with plant spacing was 45x60 cm. *Synedrella nodiflora* was planted in the 9 block (size 3x4 m^2). Native *Synedrella nodiflora* was taken for descriptive comparation.

Research implementation

Planting and fertilization. Planting material is *S. nodiflora* from the field. After the soil processed using a hoe, thus fertilized and planted with a distance 45x60cm, with one plant for each hole.

Defoliation. Harvesting was done at the 5 week after planting. Stem was cut 5 cm above the ground surface. Data were taken during harvest time as forage fresh production.

Sample preparation

Preparation. All samples were taken from the field was weight then put in a paper bag. Samples were dried in the oven of 55^0C for approximately three (3) days to obtain a constant dry weight. The dried samples were ground using *wiley mill* with 1 mm screen filter porosity.

Proximate analysis. Samples were analyzed to determine the plant chemical composition such as dy matter, ash (AOAC, 2005). TDN was calculated for cattle or sheep (Hartadi *et al*., 2005).

***In vitro* digestibility analysis.** The samples were analyzed to determine the evaluation of feed digestibility by using the Tilley and Terry (1963). The first phase includes the treatment fermentation of feedstuffs use the microbe fresh rumen fluid for 48 hours. The second stage simulated the digestion that occurs in the post-rumen digestive organs. Coefficient value of digestibility obtained from *in vitro* analysis the results with *in vivo* (Tilley and Terry, 1963).

Research variable

Plant height. The growth of plant height data were taken once a week. It was measured from the ground up to the highest part of the plant.

Fresh production. Plant weight at harvest (kg/plot) was converted into tons/ha. Total production every bed in every m^2 (kg) will be basic data for calculating production in ton/ha.

Production of dry matter. The weight of the plant at harvest (kg/plot) was converted in tons/ha, then multiplied by result of dry matter.

Production of organic matter. The results of dry matter production multiplied by organic matter.

Chemical composition. The nutrient content of each plot was analyzed such as dry matter (DM), organic matter (OM), crude protein (CP), extract ether (EE), crude fiber (CF), nitrogen free extract (NFE) (AOAC, 2005). Total digestible nutrients (TDN) was obtained by calculation (Hartadi *et al*., 2005).

Digestibility *in vitro.* Dry matter digestibility (IVDMD) and two-stage of dry matter and organic matter digestibility (IVDOM) was obtained by (Tilley and Terry,1963).

Data analysis

The data obtained were tabulated and analyzed by a one-way ANOVA with SPSS 23.00 s*oftware* for all parameters. To reveal the differences among parameters, *Least Significant Different* (LSD) was applied as presented by Astuti (2007).

Result and Discussion

Plant growth

Plant height. The results of statistical analysis shows that the fertilizer increased the height of plants ($P<0.05$). Plant height of C, D and DU were 41.59, 47.42, and 50.59 cm,

Table 1. The height of the S*yndrella nodiflora* (L.) plant

Sample	Height (cm)	Height increase/week (cm)
Control (C)	41.59 ± 5.35[a]	7.48 ± 1.07[a]
Organic fertilizer(D)	47.42 ± 5.41[b]	8.63 ± 1.25[b]
Organic fertilizer + urea (DU)	50.59 ± 7.72[b]	9.39 ± 1.83[b]
Average	46.53 ± 2.50	8.50 ± 1.38

[a,b] Superscript followed by different letter on the same parameters show significant different (p<0.05).

respectively. The height increase of C, D and DU plants were 7.48, 8.63, and 9.39 cm/week, respectively.

The observations obtained that the addition of organic and inorganic fertilizers affected plant height. This is in accordance with the opinion of Setyorini *et al.* (2013) which states that the compost (organic fertilizer) improves the quality of soil fertility physically, chemically, and biologically. Sutejo and Kartasapoetra (1990) states that the use of nitrogen which reaches a certain limit in large quantities will cause higher crop production.

Plant production

The result of production variable on treated *S. nodiflora* (C, D, and DU) can be seen in Table 3. The results of statistical analysis showed that fertilizer increased the fresh production, dry matter and organic matter in the *S. nodiflora* (P<0.05). Fresh production of *S.nodiflora* C, D and DU were 8.27, 10.83 and 17.08 tons/ha, respectively. The dry matter production of *S.nodiflora* plants C, D and DU were 1.69, 1.70 and 2.91 tons/ha, respectively. The organic matter production of *S.nodiflora* plants C, D and DU were 1.46, 1.46 and 2.59 tons/ha, respectively. Based on these data, the combination of organic fertilizer and urea shows the best results of fresh, dry matter and organic matter production.

Fertilization is a way to improve soil quality which ultimately has an impact on crop productivity. Lingga and Marsono (2008) stated that nitrogen is absorbed by plants during the growth period until the seeds are ripened. The application of organic fertilizers in addition to increase the availability of nutrients, can also improve soil physical properties such as aggregate stability, volume weight, total pore space, plasticity and water holding (Sarief, 1989). Dewanto *et al.* (2013) stated that the fertilizers applied to plants are organic fertilizers and inorganic fertilizers. The application of organic fertilizers can improve soil structure, increase soil absorption material for water, and increase the living conditions of soil microbes and as a source of food for plants. Application of inorganic fertilizers can stimulate overall plant growth and aid in the formation of green leaves.

Chemical composition

The results of testing of secondary metabolites from samples D were tannins (0.51%), saponins (0%), phenols (0.48%) and flavonoids (0.45%). Secondary metabolites levels of *S nodiflora* were lower than *Calliandra calothyrsus* and *Leucaena leucocephala*. The chemical composition of *Calliandra calothyrsus* plants harvested at 6 weeks according to Abqoriyah *et al.* (2015) namely dry matter (26.51%), organic matter (93.43%), crude protein (21.09%), extract ether (1.51%), crude fiber (15.80%), nitrogen free extract (50.28 %), and total digestible nutrients (65.46%). *Leucaena leucocephala* contains secondary metabolites in the form of tannins 3.48% (DM basis) (Soltan, 2013).

The results of proximate analysis of *Syndrella nodiflora* (L.) native dry matter (17.32%), organic matter (84.46%), crude protein (20.11%), crude fiber (13.26%), extract ether (7.77%), nitrogen free extract (37.08%), TDN for cattle (62.45%) and for sheep (67.42%). The results of proximate analysis on treated *Syndrella nodiflora* can be seen at Table 2.

The results of statistical analysis showed that fertilizer decreased plant dry matter, but increased organic matter (P<0.05). The dry matter of C, D and DU were 20.42, 15.84 and 17.40% respectively. The organic matter of native C, D and DU respectively 86.37, 85.65 and 89.06%. The native dry matter and organic matter 17.32 and 84.46% respectively.

The chemical composition of *Synedrellla nodiflora* according to Isah *et al*. (2012) were 16.38% dry matter, 92.35% organic matter, 25.61% crude protein, 5.88% crude fat, 7.65% ash, 30% *neutral detergent fiber*, 18% *acid detergent fiber*, 5.20% lignin, and 22% hemicellulose. Fertilizer treatment of *Syndrella nodiflora* (L.) in this study affect dry matter and organic matter.

The results of proximate analysis in this research of *S nodiflora* (L.) were dry matter (17.32%), organic matter (84.46%), crude protein (20,11%), crude fiber (13.26%), crude fat (7.77%), nitrogen free extract (37.08%), TDN for cattle (62.45%) and TDN for sheep (67.42%). The

Table 2. Dry matter (DM) and organic matter (OM) of the *Syndrella nodiflora* (L.) plant

Sample	Chemical Composition (%)	
	Dry matter	Organic matter
Control	20.42 ± 0.43[a]	86.37 ± 1.81[ab]
Organic fertilizer	15.84 ± 0.51[b]	85.65 ± 3.43[a]
Organic fertilizer + urea	17.40 ± 1.79[b]	89.06 ± 1.63[b]
Average	17.74 ± 1.91	86.39 ± 2.51

[a,b] Superscript followed by different letter on the same parameters show significant different (P<0.05).

Table 3. Forage production of *Syndrella nodiflora* plants

Sample	Production (ton/ha)		
	Fresh	Dry matter (DM)	Organic matter (OM)
Control	8.27 ± 1.12[a]	1.69 ± 0.24[a]	1.46 ± 0.21[a]
Organic fertilizer	10.83 ± 4.73[ab]	1.70 ± 0.71[a]	1.46 ± 0.62[a]
Organic fertilizer + urea	17.09 ± 5.13[b]	2.91 ± 0.59[b]	2.59 ± 0.48[b]
Average	12.06 ± 5.28	2.10 ± 0.77	1.83 ± 0.69

[a,b] Superscript followed by different letter on the same parameters show significant different (P<0.05).

Table 4. *In vitro* digestibility of *Syndrella nodiflora* plants

Sample	IVDMD	IVOMD
Control	57.70 ± 0.69[a]	61.98 ± 0.93[a]
Organic fertilizer	50.81 ± 0.19[b]	51.71 ± 2.62[b]
Organic fertilizer + urea	51.68 ± 2.61[b]	54.84 ± 4.65[b]
Average	53.39 ± 3.52	56.18 ± 5.30

[a,b] Superscript followed by different letter on the same parameters show significant different (P<0.05).

results of secondary metabolites analyses from samples of with dung fertilizer *S nodiflora* (L.) were 0.51% tannins, 0% saponins, 0.48% phenols and 0.45% flavonoids.

It is possible for the same plant species to have different nutritional qualities if harvested from different places, different ages, treat fertilizers, and other environmental elements. It is because the factors affect the performance of a plant are not only genetic factors but also the environment. Gerik *et al.* (2013) stated that plant productivity is influenced by two factors, namely genetic and environmental factors such as light, temperature, humidity, nutrients or mineral salts, and oxygen. Arpah (2001) stated that one of the factors that can affect the nutritional quality of a feed ingredient is environmental factors, which environmental factors include temperature, pH, humidity, microorganisms, and the condition of the feed ingredients. Purbajanti (2013) argues that the crude protein content of forage is influenced by the type of plant, growth stage, soil fertility, climate (season), temperature, light intensity, and water stress.

***In vitro* digestibility**

Data of *in vitro* dry matter and organic matter digestibility analysis can be seen in Table 4.

Dry matter digestibility. The statistical analysis showed that fertilizer treatment decreased dry matter digestibility (IVDMD) of *S.nodiflora* (P<0.05). One stage *In vitro* dry matter digestibility (48 hours) (Tilley and Terry,1963) of control samples was 57.70%, the D fertilizer was 50.81%, and the DU fertilizer was 51.68%. This result was lower compared with research done by Isah *et al*. (2012) reported that *In vitro* digestion was 50% IVDMD (24 hours), 65% IVDMD (48 hours). This is normal when viewed from the nutritional content of plants that are different. One of them is the crude protein content of *S nodiflora* in this study was lower than in the literature. Purbajanti (2013) stated that in vitro dry matter digestibility was positively related to crude protein content, but negatively related to dry matter, ADF and lignin.

Organic matter digestibility. The results of statistical analysis showed that fertilizer decreased the *in vitro* organic matter digestibility (IVOMD) of *S. nodiflora* plants (P<0.05). The results of one stage *In vitro* organic matter digestibility one stage according to Tilley and Terry (1963), the control sample was 61.98%, D fertilizer was 51.71%, and DU fertilizer was 54.84%. This result was lower compared with research done by Isah *et al*. (2012) reported that organic matter *in vitro* digestibility was 45.86%. Wahyuni *et al.* (2014) stated that the *in vitro* digestibility of forages is influenced by the fiber components consisting of cellulose and lignin. In addition, the crude fiber and lignin components also have the ability to inhibit fermentation in vitro, so that the higher the crude fiber contents, the lower *in vitro* digestibility.

Conclusions

The fertilizers combination (organic fertilizer + urea) increase the plant height, fresh and dry matter production of *Synedrella nodiflora*. *Synedrella nodiflora* (L.) potential for feed with good nutrient content without anti nutrition that dangerous for animal.

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