EFFECT OF TYPE AND DOSAGE OF FOLIAR FERTILIZERS ON DIGESTIBILITY AND NUTRIENT CONTENT OF BUTTERFLY PEA (*CLITORIA TERNATEA*

PENGARUH JENIS DAN DOSIS PUPUK DAUN TERHADAP KECERNAAN DAN KANDUNGAN NUTRIEN KEMBANG TELANG (*Clitoria ternatea*)

AN. Sariffudin[a], N Umami[b], B. Suhartanto[b] , SN. Ahmad[c]

[a] Balai Penerapan Standar Instrumen Pertanian Kepulauan Riau, Jalan Pelabuhan Sungaijang No. 38 Tanjungpinang, 29124
[b] Departemen Nutrisi dan Makanan Ternak Fakultas Peternakan, Universitas Gadjah Mada, Jalan Fauna No.3, Karang Gayam, Catur Tunggal, Kec. Depok, Kab. Sleman, Yogyakarta, 55281
[c] Peneliti dari Badan Riset dan Inovasi Nasional, Jalan M.H. Thamrin No. 8 Kebun Sirih, Menteng, Jakarta Pusat, 10340
corresponding author : AN Sariffudin : Email :

(Diterima oleh Dewan Redaksi: 14 Desember 2023)
(Dipublikasikan oleh Dewan Redaksi: 30 April 2024)

ABSTRACT

The study aimed to determine the effect of the type and dose level of foliar fertilizers on the nutrient content and *in vitro* digestibility of *Clitoria ternatea*. The research was conducted at Faculty of Animal Science, Gadjah Mada University. The materials used were butterfly pea seeds, rabbit liquid organic and Gandasil®D fertilizer, rumen fluid. The study analysed by Completely Randomized Design (CRD) with factorial 2x4. The first factor was the type of foliar fertilizer (rabbit liquid organic and Gandasil®D fertilizer). The second factor was the level of fertilizer dosage (0, 1.5, 3 and 4.5 g/l/plot). Parameters observed were DM, OM, Ash, CP, CF, Crude Fat, in *vitro* dry matter and organic matter digestibility (IVDMD/IVOMD). Data were analyzed by variance analysis at 5%, continued with Duncan's Multiple Range Test (DMRT). The results showed that the types of foliar fertilizers didn't significantly affect the nutrient content (P>0.05), but had a significant effect on IVDMD and IVOMD (P<0.05). The dose level had a significant effect on CP, CF, IVDMD, IVOMD (P<0,05), but not significant effect on DM, OM, and crude fat (P>0.05). There was an interaction between type and dose level of foliar fertilizer on IVDMD and IVOMD (P<0.05). The conclusion is the type of foliar fertilizer doesn't affect the nutrient content while the level of fertilizer dosage has a significant effect. There is a combination of foliar fertilizers and dose levels on IVDMD and IVOMD. The combination of Gandasil®D fertilizer with dose level of 4,5 g/l/plot got the best IVDMD and IVOMD.

Keyword: Type of fertilizer, Dosage level, Nutient content, In vitro digestibility, Clitoria ternatea

ABSTRAK

Tujuan penelitian untuk mengetahui pengaruh pemberian jenis dan level dosis pupuk daun terhadap kandungan nutrisi dan kecernaan *in vitro* tanaman kembang telang (*Clitoria ternatea*). Penelitian dilakukan di Fakultas Peternakan, Universitas Gadjah Mada, Yogyakarta. Materi yang digunakan adalah bibit kembang telang, pupuk organik cair (POC) kelinci, pupuk Gandasil®D, cairan rumen. Penelitian menggunakan rancangan acak lengkap (RAL) faktorial 2x4 dengan 3 ulangan. Faktor pertama yaitu jenis pupuk daun (POC kelinci dan Gandasil®D). Faktor kedua yaitu level dosis pupuk daun (0, 1,5, 3 dan 4,5 g/L/plot). Parameter yang diamati yaitu kandungan nutrisi (BK, BO, Abu, PK, SK, LK), kecernaan bahan kering (KcBK) dan bahan organik (KcBO) secara *in vitro*. Data dianalisis dengan analisis variansi dengan uji lanjut *Duncan's New Multiple Range Test* (DMRT) 5%. Hasil penelitian menunjukkan jenis pupuk daun tidak berpengaruh nyata terhadap kandungan nutrisi (P>0,05), tetapi berpen7890garuh nyata terhadap KcBK dan KcBO secara *in vitro* (P<0,05). Perlakuan level dosis pupuk daun berpengaruh nyata terhadap kandungan PK, SK, KcBK dan KcBO (P<0,05), namun tidak berpengaruh terhadap kandungan BK, BO dan LK (P>0,05). Terdapat interaksi antara jenis dan level dosis pupuk daun terhadap KcBK dan KcBO secara *in vitro* (P<0,05). Kombinasi pupuk Gandasil®D dosis 4,5 g/l/plot mendapatkan KcBK dan KcBO tertinggi yaitu 68,66 dan 65,09%. Kesimpulannya

adalah jenis pupuk daun tidak berpengaruh terhadap kandungan nutrisi tanaman, akan tetapi berpengaruh terhadap KcBK dan KcBO sedangkan level dosis pupuk berpengaruh nyata. Terdapat kombinasi antara jenis dengan level dosis pupuk daun terhadap KcBK dan KcBO. Kombinasi pupuk Gandasil®D dosis 4,5 g/l/plot mendapatkan KcBK dan KcBO terbaik.

Kata kunci: Jenis pupuk, Level dosis, Kandungan nutrisi, Kecernaan *in vitro*, Kembang telang

AN Sariffudin, Numami, B Suhartanto, SN Ahmad. 2024. Pengaruh Jenis Dan Dosis Pupuk Daun Terhadap Kecernaan Dan Kandungan Nutrien Kembang Telang (*Clitoria Ternatea*). *Jurnal Peternakan Nusantara* 10 (1) 65-72

BACKGROUNDS

The ruminant livestock industry cannot be separated from the feed factor in the form of both concentrates and forages. This is because feed can affect livestock productivity. Especially for forage, it is needed by livestock in large quantities to meet the needs of basic life, production and reproduction. The availability of forage in Indonesia generally depends on the season. The availability of sustainable and quality forage is a determining factor in the productivity of a livestock. Therefore, good quality forage is needed so that it can meet the needs of livestock. Leguminous plants are forage that have a high protein content, one of which is Butterfly pea (*Clitoria ternatea*).

Butterfly pea is a perennial legume plant (can live in the annual period). So that with good slaughter management, the availability of this forage can meet the needs of livestock within a certain period of time. Butterfly pea originated in central South America and then spread to the tropics since the 19th century, especially to Southeast Asia including Indonesia. Butterffly pea can grow at an altitude of 0 – 1,600 m above sea level with an average temperature of 19 – 28^{0}C in the pH range of 5.5 – 8. Butterfly pea are resistant to rainfall in the range of 500 – 900 mm (Sutedi 2013). Butterfly pea harvested for the first time at the age of 45 days have a chemical composition of 25% crude fiber, 17% crude protein, 3% crude lipid and 12.7% ash (Mahala *et al*. 2012), while butterfly pea harvested for the second time at the age of 42 days have crude protein and crude fiber content of 17.96 and 52.13% respectively (Syamsuddin *et al*. 2016).

Chemical composition is closely related to feed digestibility. The higher the digestibility of feed ingredients, the higher the nutrients that can be utilized by livestock. The quality of butterfly pea can be seen from the value of crude fiber (CF) and crude protein (CP). The higher the crude fiber contained in the plant, it can reduce the degradability of a feed, this will result in a decrease in digestibility, while the higher the crude protein content, the population of microorganisms in the rumen increases so that the ability of livestock to digest feed becomes greater.

One way to improve the quality of butterfly pea is by fertilizing if given at the right dose. Doses that are too high can cause plant leaves to burn or can even cause plants to die. The type of foliar fertilizer that is already familiar in the community is Gandasil®D fertilizer. Another alternative foliar fertilizer is to use rabbit urinee liquid organic fertilizer. The content of N, P and K in rabbit urinee liquid organic fertilizer are 4, 2.8 and 1.2%, respectively (Sembiring *et al*. 2017).

MATERIALS AND METHODS

The research was carried out at the Forage Research Garden for Animal Feed and Pasture in from September to November 2020, while observations of forage quality and digestibility were carried out at the Laboratory Forage Research Garden for Animal Feed and Pasture, Faculty of Animal Science, Gadjah Mada University in March 2021. The tools used are laboratory equipment for analyzing nutrient content and testing the *in vitro* dry matter and organic matter digestibility. The materials used in this study were Gandasil®D leaf fertilizer, rabbit urinee liquid organic fertilizer, 96 seeds of Butterfly Pea (*Clitoria ternatea*) aged 1 month, and rumen fluid from cattle with fistula. Fertilizer application was carried out by spraying liquid fertilizer directly on the plant leaves. Spraying is done on the back of the leaves where the stomata are located and is done at 07.00 - 09.00 WIB given once a week. Harvesting was done after the plants were 45 days old with a cutting limit of 20 cm above the soil surface.

The study was done based on completely randomized experimental design (CRD) with a

factorial 2x4. The first factor (A) was the type of foliar fertilizer, consisting of rabbit urine liquid organic fertilizer and gandazil®D fertilizer. The second factor (B) was the dose level, consisting of 0, 1.5, 3.0 and 4.5 g/l/plot. The treatment combinations were repeated 3 times, so there was a total of 24 plots. Parameters observed were feed nutrient content including dry matter (DM), organic matter (OM), ash, crude protein (CP), crude fiber (CF), crude fat, and in *vitro* dry matter and organic matter digestibility (IVDMD/IVOMD). The analysis of feed nutrient content was calculated using the AOAC (2005) method, while the analysis of *in vitro* dry matter and organic matter digestibility refers to the method of Tilley and Terry (1963).

Table 1. The content of nutrients in rabbit urine liquid organic fertilizer and gandasil®D

Nutrient	Fertilizer	
	Rabbit urine liquid organic fertilizer*)	Gandasil®D**)
N-Total (%)	0.25	20
P-Total (%)	0.18	15
K-Total (%	0.2	15
Cu-Total (%)	20	
Fe-Total (%)	1800	
Mn-Total (%)	180	

*Result analysis of laboratory Balingtan (2020)
**Palemba et al, (2013)

RESULTS AND DISCUSSION

Research Soil Conditions

The research location was at the Forage Research Garden for Animal Feed and Pasture, Faculty of Animal Science, Gadjah Mada University. The nutrient content of the research land is presented in Table 2.

Table 2. Soil nutrient content of the research

Nutrients	Unit	Results (Ananta, 2019)	Value (Yamani, 2012)
pH	-	6,87	Neutral
C-Organic	%	5.46	-
N-Total	%	0.57	High
P_2O_5	me/100 g	18	Low
K_2O	me/100 g	6	Very Low
C/N		9.58	

The research soil contained 5.46% C-organic, slightly lower than the standard C-organic content in PERMENTAN No. 70/Permentan/SR.140/10/2011 which is a minimum C-organic content of 6%. The content of macro nutrients in the research soil was 5.46% N, 18 me/100 g P and 6 me/100 g K. Soepraptohardjo (1983) in the manuscript of Yamani (2012) stated that the N content of 0.57% was high, the P content was low and the K nutrient content was very low. The N content is needed by plants to carry out the photosynthesis process and is also used to stimulate the vegetative growth of plants. High nutrient content in a field will affect production. High nutrient content in a field will affect the production of plants. Solichin and Badrudin (2020) stated that the N content has a major role in plants, namely as a constituent element of the plant. in plants, namely as a constituent element of protein and is an element in the chlorophyll molecule. The C/N ratio of the research soil was 9.58. According to Sumarni *et al*. (2010) the C/N ratio of 9 is classified as low.

Nutrient Content of Clitoria ternatea

The type of fertilizer had no significant effect on nutrient content of Butterfly pea (DM, OM, Ash, CP, CF, Crude Fat) (P>0,05) but significantly affected the *in vitro* dry matter and organic matter digestibility (IVDMD, IVOMD) (P<0,05). The dose level of foliar fertilizer had a significant effect on crude protein (CP), crude fiber (CF), as well as *in vitro* dry matter and organic matter digestibility (IVDMD, IVOMD) (P<0,05), but had no significant effect on leaf area, content of DM, OM, ash and Crude fat (P>0,05). The nutrient content of the Butterfly pea has been presented in Table 3.

Table 3. The effect of type and dose level of foliar application on nutrient content of butterfly pea (*Clitoria ternatea*)

Treatment	Parameter					
	DM (%)	OM (%)	Ash (%)	CP (%)	CF (%)	Crude Fat

						(%)
Type fertilizer						
A1	88.54±3.3[a]	88.92±2.4[a]	11.08±2.4[a]	23.78±1.5[a]	33.23±2.5[a]	2.54±0.1[a]
A2	88.93±3.6[a]	89.52±2.1[a]	10.48±2.1[a]	23.57±1.2[a]	32.24±2.8[a]	2.54±0.3[a]
Dose level						
0 g/l/plot	89.92±3.4[a]	89.68±1.5[a]	10.32±1.5[a]	22.15±1.4[a]	33.98±1.7[a]	2.53±0.2[a]
1.5 g/l/plot	89.10±2.5[a]	87.32±1.3[a]	12.68±1.3[a]	23.64±0.7[b]	33.65±1.5[a]	2.49±0.2[a]
3.0 g/l/plot	88.46±3.3[a]	90.43±1.9[a]	9.57±1.9[a]	24.30±0.8[b]	33.34±3.4[a]	2.62±0.4[a]
4.5 g/l/plot	87.44±4.3[a]	89.45±2.9[a]	10.55±2.9[a]	24.59±0.5[b]	29.97±1.6[b]	2.50±0.1[a]
P Value						
Type fertilizer	0.79	0.46	0.46	0.63	0.08	0.98
Dose level	0.68	0.07	0.07	0.01	0.00	0.69
Interaction	(-)	(-)	(-)	(-)	(-)	(-)

[a,b]Different superscripts in the same column showed significant differences (P<0,05).

Deskripsi :

A1 = Rabbit urine liquid organic fertilizer

A2 = Gandazil®D fertilizer

Dry Matter (DM)

Dry matter content obtained in the research ranged from 87.46 - 89.93%. The dry matter content obtained was slightly lower than the results of Hartutik *et al*. (2012) where in their research the dry matter content of Clitoria ternatea harvested at the age of 90 days was 90.29%. Harvesting age can cause high or low dry matter content of a crop. Plants that are harvested at a young age have active cells, while plants that are harvested at an old age tend to have a a high dry matter content due to the thickening of the cell walls. This is in accordance with the opinion of Keraf *et al*. (2015) that the older the plant, the less water content and the proportion of its cell wall will be higher than that of its cell wall.

Although not significantly different, the use of Gandasil®D fertiliser produced a slightly higher dry matter content than rabbit urine liquid organic fertilizer at 88.93%. This may be due to the higher content of macronutrients, especially N content in Gandasil®D fertiliser. The N content will be used by plants to build protein and chlorophyll. This is in accordance with the opinion of Muwakhid and Ali (2021) that plants given N fertilizer can effectively increase the nutrient content of plant include dry matter content.

Organic Matter (OM)

The results obtained are a little higher than those of Hutasoit et al. (2017) where in their research the organic matter content butterfly pea was 86.66%. The results were not significantly different at all treatment is thought to be caused by the ability of the butterfly pea meet the needs of nutrients from the soil. Ability butterfly pea can fix nitrogen (N) from the free air so that the role of foliar fertilizer may be less influential.

The organic matter content of butterfly pea can be affected by the variety crop and harvest or cutting age. According to Jelantik et al. (2019) that butterfly pea harvested at different ages had a significant effect on the organic matter content. The cause of the organic matter content is the same because the butterfly pea in the research was harvested at the same age. According Asturi *et al*. (2019) the longer the harvesting time is then the results of photosynthesis will accumulate a lot so that the level of organic matter can increase.

Ash

The type and dosage level of foliar fertilizer had no significant effect on the ash content of butterfly pea (P>0.05). Ash content research results ranged from 9.57-12.68%. Ash content of all treatments no different because the dose level of fertilizer given has not been fully utilized by plants. The ash content obtained was in accordance with the research ash content from Mahala *et al*. (2012) where the butterfly pea was harvested at the age of 45 days has an ash content of 12.7%.

Crude Protein (CP)

Types of foliar fertilizer treatment between rabbit urine liquid organic fertilizer and

gandasil®D not significantly different even though the N content was far away different (Table 1). This could be due to the plant's need for nutrients have been fulfilled from the soil. Dose level of fertilizer 1.5, 3 and 4.5 g/l/plot showed no significant difference to crude protein content of butterfly pea. (P>0.05) but significantly different from not fertilizer (P<0.05). Crude protein results from the research ranged from 22.15 – 24.59%, is higher than research results Hutasoit *et al*. (2017) and Jelantik *et al*. (2019) where in his research found the crude protein content Clitoria ternatea respectively 18.16% and 17.59 – 19%. The higher the dose of fertilizer used, the more it will be nutrient content in it, so that the absorption of N elements by plants also increased. According to Muwakhid and Ali (2021) that element N function to compose prateins so that nitrogen fertilization through foliar fertilizer will produce more protein a lot and quickly so the CP content increases.

Crude Fiber (CF)

The type of foliar fertilizer has not significant effect on the crude fiber content of the butterfly pea (P>0.05), in contrast to the treatment of the dose level of foliar fertilizer which had an effect significantly to crude fiber content (P<0.05). The highest crude fiber content was shown without fertilizer treatment and the lowest crude fiber content was at the treatment dose level of 4.5 g/l/plot each of 33.98 and 29.97%. The range of crude fiber values still relatively normal. The results obtained are in accordance with Hartutik *et al*. (2012), where in his research it was found the crude fiber content of plants butterfly pea by 32.99%. The higher the dose level of foliar fertilizer given, the crude fiber content of the butterfly pea has decreased becaused the nutrient contained (N, P, K) in it are also getting higher. Nuraeni *et al*. (2019) stated that giving high nitrogen to plants can result in depletion of plant cell wall material. Reduced crude fiber content improve the quality of the butterfly pea plant, because crude fiber is fractions that are difficult for ruminants to digest. Astuti *et al*. (2019) added that the crude fiber content will be reduced if the content increased plant crude protein.

Crude Fat

The crude fat content of the research results ranged from 2.50 – 2.62%, higher than the results of Hartutik *et al*. (2012) and lower than research results Jelantik *et al*. (2019) where in their research it was found the crude fat content of the butterfly pea is 1.75 and 6.39%, respectively. There was no significant difference between all treatments at the level of fertilizer this is due to the dry matter (DM) content of the butterfly pea as well not significantly different. The content of DM was the same for all treatments cause the crude fat content produced is relatively the same. According to Astuti *et al*. (2019) that the calculation of crude fat content is obtained from the content crude fat multiplied by the DM content of the plant. Crude fat content research results are still relatively normal, because according to Preston and Leng (1987) in the manuscript Yuvita *et al*. (2020), stated that the standard fat content crude ruminant feed ingredients range below 5%. Fat content that is too high in feed ingredients does not guarantee good feed quality. However the high crude fat content will interfere with the process fermentation of feed in the rumen.

In Vitro Dry Matter and Organic Matter Digestibility (IVDMD/IVOMD)

The type and level dose of foliar fertilizer significantly affected the *in vitro* dry matter and organic matter digestibility of the butterfly pea (P<0.05). The *in vitro* dry matter and organic matter digestibility of the butterfly pea shown in the Table 4.

Table 4. The *in vitro* dry matter and organic matter digestibility of the butterfly pea (%)

Type fertilizer	Level Dosage (g/l/plot)	Average

	0	1.5	3.0	4.5	
IVDMD					
A1	63.22	64.94	63.70	66.26	64.53±1.26[a]
A2	63.97	64.55	67.64	68.65	66.21±2.25[b]
Average	63.60±1.0[a]	64.75±0.6[b]	65.67±2.21[c]	67.46±1.3[d]	
IVOMD					
A1	58.77	61.65	60.52	62.38	60.83±1.44[a]
A2	61.52	62.00	63.67	65.09	63.07±1.64[b]
Average	60.15±1.5[a]	61.83±0.6[b]	62.09±1.9[b]	63.73±1.5[c]	

[a,b,c,d]Different superscripts in the same row and column showed significant differences (P<0,05).

Deskripsi :
A1 = Rabbit urine liquid organic fertilizer
A2 = Gandazil®D fertilizer

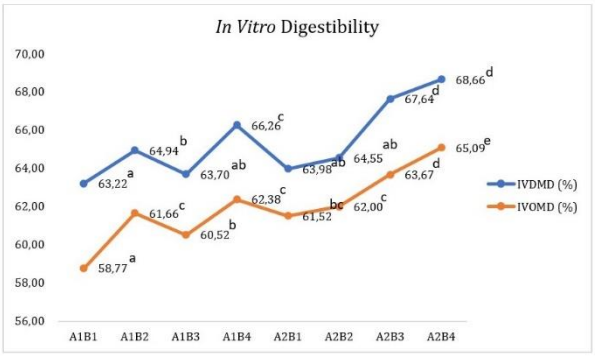

Figure 1. In vitro dry matter and organic matter digestibility butterfly pea.

In Vitro Dry Matter Digestibility (IVDMD)

Digestibility of dry matter butterfly pea with Gandasil®D fertilizer higher than the rabbit urine liquid organic fertilizer. This can be due to the content of macro nutrients N, P and K in Gandasil®D fertilizer was higher than rabbit urine liquid organic fertilizer. This N content will be utilized by rumen microbes for carry out protein synthesis. The more N contained in the feed the result of protein synthesis is high so that the *in vitro* dry matter digestibility (IVDMD) is high. According to Ayuningsih *et al*. (2018) that rumen microbes requires N available in the feed to develop and activate. *In vitro* dry matter digestibility in treatment dose levels fertilizer (0, 1.5, 3 and 4.5 g/l/plot) were significantly different from each other.

The difference between these treatments can be caused by the influence of elements nutrients contained in each dose of fertilizer. The higher the dose fertilizer, nutrient content is also higher. This has an effect on the nutritional content of the butterfly pea can also affect in digestibility value. Increasing the dose level of foliar fertilizer given can reduce the DM content of the butterfly pea. The low DM content means that rumen microbes will easily degrade it rumen feed to increase dry matter digestibility. This is appropriate the opinion of Wijayanti *et al*. (2012) that the lower DM content, the the cell walls of the feed are getting thinner so that the rumen microbes are easier degradation, resulting in increased digestibility. Figure 1 shows the interaction between the type and level dosage of foliar fertilizer on IVDMD of butterfly pea (P<0.05). Giving settings the dosage level of foliar fertilizer needs to be done to improve the quality of the butterfly pea plants. Figure 1 shows that the *in vitro* dry matter digestibility (IVDMD) the highest was obtained from the type of foliar fertilizer Gandasil®D with dose level of 4.5 g/l/plot, which is 68.66%.

In Vitro Organic Matter Digestibility (IVOMD)

Digestibility of organic matter butterfly pea with Gandasil®D fertilizer higher than the rabbit urine liquid organic fertilizer. This is caused by both types of fertilizer treatment have different characters. Rabbit urine liquid organic fertilizer is an organic fertilizer while gandasil®D fertilizer is anorganic fertilizer. Organic fertilizers take a relatively long time to decompose when compared to anorganic fertilizers as a result of the process of photosynthesis of butterfly pea that was given gandasil®D fertilizer occurred faster. According to Wibowo *et al*. (2017), the results of photosynthesis are very decisive, plant growth is usually expressed in terms of dry matter and organic matter production. Fathul and Wajizah (2010) adding when the dry matter content increases, the organic matter content also increased.

The highest *in vitro organic* matter digestibility (IVOMD) content was obtained by treatment the dose level of 4.5 g/l/plot is 63.73%. The results obtained are slightly more lower than the results of Hartutik *et al*. (2012) where the digestibility of the organic matter butterfly pea results on his research amounted to 66.28%. IVOMD of butterfly pea is lower than its IVDMD. According to Setiyaningsih *et al*. (2012) this could be due to fractions ash in dry matter undergoes a process of degradation by rumen microbes. Combination treatment between Gandasil®D foliar fertilizer with different dose levels of 4.5 g/l/plot significantly compared to other treatment combinations ($P<0.05$). Combination this treatment also resulted in the highest *in vitro* organic matter digestibility (IVOMD) that is equal to 65.09%.

CONCLUSION AND IMPLICATIONS

The type and dosage level of foliar fertilizer doesn't affect the nutrient content (except crude protein and crude fiber). The type and level dosage of fertilizer has a significant effect on IVDMD and IVOMD. There is a combination of foliar fertilizers and dose levels on IVDMD and IVOMD. The combination of Gandasil®D fertilizer with dose level of 4,5 g/l/plot got the best IVDMD and IVOMD.

REFERENCES

AOAC. 2005. Official Methods of Analysis. 18th ed. AOAC International, Gaithersburg, MD.

Astuti D, B Suhartanto, B Suwignyo and MZ Asyiqin. 2019. Pengaruh umur panen dan level pupuk nitrogen terhadap produksi dan kandungan nutrient *sorghum bicolor* L. varietas numbu. Agrinova 2(2): 9 – 16.

Ayuningsih B, I Hernaman, D Ramdani and Siswoyo. 2018. Pengaruh imbangan protein dan energi terhadap efisiensi penggunaan ransum pada domba garut betina. Jurnal Ilmiah Peternakan Terpadu 6(1): 97 – 100.

Fathul F dan S Wajizah. 2010. Penambahan mn dan cu dalam ransum terhadap aktivitas biofermentasi rumen domba secara *in vitro*. Jurnal Ilmu Ternak dan Veteriner 15(1): 9 – 15.

Hartutik, SP Th Fernandez and S Ratnawaty. 2012. Evaluation of legume herbs nutritive value as a ruminant feed and nitrogen supply on soil in west timor, indonesia. Pakistan J. Agric. Res 25(4): 323 – 331.

Hutasoit R, A Tarigan and J Sirait. 2017. Tanaman pakan leguminosa dalam sistem integrasi dengan perkebunan jeruk. Jurnal Pastura 7(1): 32 – 36.

Jelantik IGN, TT Nikolaus, CL Penu, GEM Malelak and I Benu. 2019. Produksi dan kualitas hijauan kacang kupu (*Clitoria ternatea*) yang dipanen pada umur 60, 75 dan 90 hari. PASTURA Journal of Tropical Forage Science 8(2): 76 – 80.

Keraf FK, Y Nulik and ML Mullik. 2015. Pengaruh pemupukan nitrogen dan umur tanaman terhadap produksi dan kualitas rumput kume (*Sorghum plumosum var. timorense*). Jurnal Peternakan Indonesia 17(2): 123 – 130.

Mahala AG, SO Amasiab, MA Yousif and Elsadig. 2012. Effect of plant age on DM yield and nutritive value of some leguminous plants (Cyamopsis tetragonoloba, Lablab purpureus and Clitoria (*Clitoria ternatea*). International Research Journal of Agricultural Science and Soil Science 21(12): 502 – 508.

Muwakhid B and U Ali. 2021. Pengaruh penggunaan pupuk daun "organik" terhadap produktivitas dan kualitas rumput gajah (*Pennisetum purpureum CV. Hawai)* sebagai hijauan pakan. Livestock and Animal Research 19(1): 21 – 31.

Nuraeni A, L Khairani and I Susilawati. 2019. Pengaruh tingkat pemberian pupuk nitrogen terhadap kandungan air dan serat kasar *Corchorus aestuans.* Pastura 9(1): 32 – 35.

Sembiring MY, L Setyobudi and Y Sugito. 2017. Pengaruh dosis pupuk urin kelinci terhadap pertumbuhan dan hasil beberapa varietas tomat. Jurnal Produksi Tanaman 5(1): 132 – 139.

Setiyaningsih KD, M Christiyanto and Sutarno. 2012. Kecernaan bahan kering dan bahan organik secara *in vitro* hijauan *Desmodium cinereum* pada berbagai dosis pupuk organik cair dan jarak tanam. Animal Agriculture Journal 1(2): 51 – 63.

Sumarni N, R Rosliani and AS Duriat. 2010. Pengelolaan fisik, kimia, dan biologi tanah untuk meningkatkan kesuburan lahan dan hasil cabai merah. Jurnal Hortikultura 20(2): 130 – 137.

Solichin A and U Badrudin. 2020. Pengaruh konsentrasi dan interval aplikasi pupuk organik cair urin kelinci terhadap pertumbuhan dan produksi tanaman wortel (*Daucus carota L.).* Jurnal Ilmiah Pertanian BIOFARM 16(1): 1 – 8.

Sutedi E. 2013. Potensi kembang telang (*Clitoria ternatea*) sebagai tanaman pakan ternak. WARTAZOA 23(2): 51 – 62.

Syamsuddin, T Saili and A Hasan. 2016. Hubungan pemberian pupuk kendang sapi dengan peningkatan kandungan protein dan serat kasar legum *Clitoria ternatea* sebagai hijauan pakan ternak. Jurnal Ilmu dan Teknologi Peternakan Tropis 3(2): 81 – 86.

Tilley JMA and RA Terry. 1963. A two stage technique for *in vitro* digestion of forages crops. Journal of the British Grassland Society 18: 104 – 111.

Wibowo T, DR Lukiwati and Sumarsono. 2017. Nilai kecernaan in vitro bahan organik (KcBO) dan bahan kering (KcBK) rumput gajah (*Pennisetum purpureum schumach & Thonn*) dengan pemupukan organik dan anorganik serta inokulasi mikroorganisme efektif (em4). Jurnal pengembangan Penyuluh Pertanian 14(26): 75 – 80.

Wijayanti E, F Wahyono and Surono. 2012. Kecernaan nutrien dan fermentabilitas pakan komplit dengan level ampas tebu yang berbeda secara *in vitro.* Animal Agricultural Journal 1(1): 167 – 179.

Yamani A. 2012. Analisis kadar hara makro tanah pada hutan lindung gunung sebatung di kabupaten kotabaru. Jurnal Hutan Tropis 12 (2): 181 – 187.

Yuvita D, J Mustabi and A Asriany. 2020. Pengujian karakteristik dankandungan lemak kasar silase pakan komplit yang berbahan dasar eceng gondok (*Eichornia crassipes*) dengan lama fermentasi yang berbeda. Buletin Nutrisi dan Makanan Ternak 14(2): 14 – 27.