Effects of Fertilizer Type on Morphological Characterstics, Forage Yield, Seed Yield and Qualities of Rhodes Grass (*Chloris gayana* K.) in Northwestern Ethiopia

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Abstract

The experiment was conducted to determine the effects of fertilizer types on plant characteristics, forage yield, seed yield and chemical composition of Rhodes grass at Bahir Dar, Ethiopia. The experiment was laid in a randomized complete block design (RCBD). The treatments were: no fertilizer (T1), Bio-slurry compost (T2), NPS fertilizer (T3) and mixture of bio-slurry and NPS (T4) with four replications. Data collected were morphological characteristics such as plant height (PH), number of tillers per plant (NTPP), leaf length per plant (LLPP), leaf to stem ratio (LSR), number of leaves per plant (NLPP), forage dry matter yield and forage qualities harvested at 90 days (50% of blooming stage) except seed yield at three weeks after full flowering stage. Samples of forages were weighed, dried and then ground subsamples taken for analyses of crude protein (CP), ash, dry matter (DM), acid detergent fiber (ADF), neutral detergent fiber (NDF) and acid detergent lignin (ADL). All data were subjected to two way ANOVA procedures of SAS version 9.0. The results showed that the effects of organic and inorganic fertilizer had a significant ($p<0.01$) effect on all of morphological characteristics were better result with mixing of NPS and bioslurry fertilizer application than other treatments, but a lone of bioslurry and NPS fertilizers also almost similar result but less than in some extent from combined fertilizer treatment. Combining chemical fertilizers with bioslurry gave the highest DM yield (12.63 t/ha) of forage than sole bioslurry (11.8 t/ha) and sole chemical fertilizer (12.03 t/ha). Combined chemical fertilizers with bioslurry gave the highest CP contents (11.25%) of forage than other treatments. In contrast control plot obtained lowest result in all morphological parameters. DMY, seed yield and lowest nutritive value with higher fiber contents. Therefore, the application of combination of bio-slurry and inorganic fertilizer shown the best result in terms of morphological, nutritive value, forage dry matter and seed yield followed by either of fertilizers. Hence, based on the current result, it can be concluded that use of combination of organic and inorganic fertilizer is the best fertilizer as far as Rhodes grass production is concerned in the current study area.

Keywords: Bioslurry, chemical composition, NPS, Rhodes grass

1. Introduction

Ethiopia is believed to have the largest livestock population in Africa [1]. This sub-sector plays very important role in the livelihood of smallholder farmers in the mixed crop-livestock farming system. Livestock provided main sources of draught power, nutritious foods, cash, and manures and have a big social value. However, it was not possible to bridge the gap between the ever increasing demand for animal products and the level of production because of lower productivity per head of livestock [2]. This is mainly due to constraint like poor genetic potential of indigenous breeds, feed shortage (both in quantity and quality), livestock diseases and parasites, lack of adequate livestock extension

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service, poor infrastructure and others. Among the constraints, inadequate quantity and quality of feed is identified as major constraint to livestock productivity in Ethiopia [3]. Hence it is important to find alternative feeds and introduce into the farming system was expected to help solve the severe forage deficit that the country is presently facing. However, the extension and promotion of improved forage production packages is lagging behind and not progressing as expected except for a few development projects and programs [4].

Among the improved forage crops introduced in the country is Rhodes grass (*Chloris gayana* K.*)* [5]. Due to its high dry matter yield, high seed production ability, favorable economics of cultivation, and superiority over most of other perennial forage grasses, and it could play an important role under the smallholder farmers and intensive livestock production systems [6]. Rhodes grass (*Chloris gayana* K.) has high relatively crude protein value (9-12%), fast growing, palatable and deep rooted grass which can be widely grown by small-holder farmers [7]. From seed production potential of some forage crops in sub-humid altitude areas of Ethiopia indicates that *Chloris gayana*, at an optimum seeding rate and row spacing can yield up to 700 kg/ha of seed [8]. In order to improve the availability of good quality feed: a fast growing, high yielding and nutritive forage species such as Rhode grass are required. Therefore, it is important to evaluate forages the forage growth, yield and quality as affected by organic, inorganic fertilizer and their combinations.

2. Materials and methods

Description of the study area

The experiment was conducted during 2018 cropping season at Zenzelma Kebele farmer training center (FTC), Bahir Dar city administration, northwestern Ethiopia. The experimental area is located at 570 km away from Addis Ababa and 7 km from Bahirdar town and lies between 11°.63.16' North latitudes and between 37°.45.70' East longitude an elevation of 1920 m above sea level. The annual average temperature is 20°C and annual rainfall ranges from 1428-1521 mm.

Treatments and experimental design

The field experiment was laid out in by using randomized complete block design (RCBD) which had four replications. The treatments were: no fertilizer (T1), bio-slurry compost (T2), inorganic fertilizer (NPS) (T3) and a mixture of NPS and bio-slurry compost (T4) consisting of four treatments, each replicated four times totally sixteen (16) plots. Treatments were assigned to each plot randomly within a block. The space between blocks was 1 m and between plots was 0.5 m.

Preparation of and experimental materials

The experimental site was ploughed in May and harrowed in June 2018. Rhodes grass seed was obtained from Bahirdar city administration agricultural office and seed rate of 15 kg/ ha was used. The NPS fertilizer was purchased from the farmer union association and bio-slurry compost was prepared from Zenzelma Kebele biogas beneficiary farmer through the outlet of biogas plant of cattle dung. Based on recommendation of Hailu (2010) [9] 64 qt/ha bio-slurry (31 kg in the experimental area) was applied at the timing of planting, and 0.5 kg NPS (100 kg/ha) and also a mixing of 50% of bioslurry with 50% of NPS (100 kg/ha) fertilizer application were used for the experiment.

Establishment and management practices

The grass was established by broadcasting method; seed can be mixed with soil. The Seed rate used for the experiment was15 kg/ha [10]. The Rhodes was sown on the surface; no deeper than 2 cm. Application of bio-slurry and NPS were applying at the timing of planting. Weeding was controlled by hand weeding twice after planting at monthly intervals during establishment to avoid competition.

Data collection

Morphological characteristics

Data on the morphological characteristics were recorded in each plot, using $1m^2$ area was recorded to estimate mean plant height (PH), number of tiller per plant (NTPP), number of leaves per plant (NLPP), leaf length per plant (LLPP) and leaf to stem ratio (LSR) during at the 50% of blooming stage, which is the recommended harvesting stage for perennial grasses to compromise herbage yield

and quality. Mean plant height and leaf length were measured by measuring tape from a sample area of 1 m^2mean of ten (10) randomly selected plants. The number of tillers and leaves per plants were counted from ten (10) plants that were randomly selected from the area of 1m^2each plot recorded before the time of biomass harvest. The LSR was determined by harvesting fresh sample weight of about 500 gram from a sample area of 1 m^2 in each plot, followed by partitioning the harvested biomass in to leaf and stem fractions, and drying. Then, the LSR was calculated by dividing the dry weight of leaves by the dry weight of stems.

The dry matter yield (DMY) was determined by harvesting from 1m^2 area at 50% blooming stage. At each plot fresh weight was determined by harvesting from the area of 1m^2 and measure immediately after each harvest using a sensitive balance; then sub-samples of about 500 g of fresh sample weight at each plot was taken and the fresh sample was air dried and reweighed fresh sample to determine dry matter yield expressed in ton ha^{-1}. Dry weight divided by fresh weight and multiplied by 100 to determine DM% for each sample. On the basis of these DM% and fresh biomass yield from the sample area of each plot was used to calculate total dry matter yields for each plot, then after, converted to ton per hectare.

DMY1=DM% * Fresh biomass yield * sample area

Seed yield

The seed was collected at three weeks after full flowering stage, based on Getnet et al., (2003) [11] finding maximum seed yield of Rhodes grass obtained at three weeks after full flowering stage, when the seed become hard, dry and brown color by hand was using sickles. Seed yield was measured by harvesting the seed in the sample area of 1 m^2. The mature inflorescences were harvested 10-15 cm below the panicle; then sun dried, piled for few days and manually threshed and cleaned to estimate seed yields. After threshing the seed was separated from, chaff and weed. Then the pure seeds were measured using sensitive balance and finally estimated to kg per hectare.

Forage quality analysis

Dried forage sample was ground to pass a 1 mm Wiley mill screen and stored in airtight bags to be used for different chemical analyses. The representative samples from each treatment plot were stored individually in airtight containers. Ash content was determined by igniting the dry samples in a muffle furnace at 550°C for 6 hours to burn off all the organic material, CP determination by Kjeldhal procedures [12]. The ADF, NDF, and ADL content were analyzed records to the procedures of Van [13]. Dry matter yield (DMY) was multiplied with CP content of the feed samples divided by hundred to determine crude protein yield (CPY).

Statistical analysis

The data collected on morphological characteristics, DMY, seed yield and forage quality parameters were subjected to the analysis of variance (ANOVA) using SAS, 2004 software. With the assumptions attended, analysis of variance were performed with application of the F test and, for the variables in which the F test was significant, treatment means were compared by the least significant difference test (LSD) ($p<0.05$). Differences were considered statistically significant at 5% significance level. The effect of different fertilizer on morphological characteristics, DMY, seed yield and forage quality parameters were determined by using the following model;

$Y_{ij}=\mu+R_i+Fj+E_{ij}$

Where:

Y_{ij}=dependent variable (morphological data, dry matter yield, seed yield & nutritive value)
μ=overall mean;
R_i=ith replication/block effect;
F_j=Effect of fertilizer (NPS, bioslurry, mix & without fertilizer);
E_{ij}=random error

3. Results and discussion

Effects of Fertilizer Type on Morphological Characteristics of Rhodes grass

The results show that effects of different fertilizer type on plant morphological characteristics of Rhodes grass are presented in Table 1.

Plant height (cm)

The application of different fertilizer had significant ($p<0.001$) effect on the plant height of Rhodes grass. The longest mean plant height (108.07 cm) was recorded at T4 a mixing of 50%

of bioslurry with 50% of NPS fertilizer application and then followed the application sole of bioslurry at T2 (103.35cm) almost similar with sole of NPS at T3 (102.27cm) plant height which implies that bioslurry can substitute for NPS without affecting growth of Rhodes grass. While the shortest mean plant height (83.475 cm) was observed at T1 without added fertilizer.

Table 1. Effects of different fertilizer application on plant morphological characteristics of Rhodes grass

Treatments	Variables				
	PH	NTPP	NLPP	LLPP	LSR
NPS	102.27^{b}	24.15^{b}	148.22^{b}	43.92^{a}	1.21^{a}
Bio-slurry	103.35^{b}	23.15^{b}	149.75^{b}	43.50^{a}	1.20^{a}
Mix (NPS+bio-slu)	108.07^{a}	27.50^{a}	173.05^{a}	45.92^{a}	1.18^{a}
Control	83.47^{c}	17.67^{c}	86.10^{c}	37.37^{b}	1.05^{b}
Overall mean	99.29	23.11	139.28	42.68	1.16
SEM	2.84	0.83	19.02	4.6	0.003
CV	1.69	3.95	3.13	5.03	5.02
R2	0.97	0.95	0.98	0.74	0.62
Sig	***	***	***	**	**

*=significant at 0.05; **=significant at 0.01; ***=significant at 0.001; means within column followed by the same letters are not significantly different; SE, standard error of the mean; ns=non-signifcant; CV=coefficient of varation;R2=coefficient of determination NPS=Nitrogen Phosphate and Sulfare

The higher plant height at T4 might be attributed to the gradual release of essential nutrient from chemical and bioslurry fertilizer as required by the Rhodes grass due to this efficient nutrient uptake allowing the plant to increase in plant height. Increased plant height with application of combined fertilizer was attributable to that integrated use of inorganic and organic nutrient sources result into synergy, improved conservation and synchronization of nutrient release and grass demand for its growth. On the other hand short plant height recorded in the control treatment might be due to depletion of nutrients from control plots over time hence plants showed stunted growth owing to inadequate supply of nutrients.

The result of the present study is agreed with the work of Baghdadi et al., (2014) [14] who reported that plant height of corn and soybean was significantly taller through a combined application of chemical fertilizer and chicken manure compared to 100% chicken manure and bio fertilizer but the same level as sole inorganic fertilizer. In addition, the present finding is in line with Biniyam et al., (2015) [15] who also reported that application of different fertilizer type (NPS and manure) significantly affected ($p>0.05$) plant height (PH) of desho grass, plant height of desho grass was significantly taller through fertilizer application compared to without fertilizer application. Similarly, the current finding agrees with that reported earlier by Takele et al., (2014) [16] who reported the application of bioslurry alone or in combination with N-fertilizer increased the plant height of the wheat over the control treatment. The current finding disagrees with Yossif and Yassin (2014) [17], who stated that plant height of Rhodes grass was not significantly affected by different types of fertilizer (urea, farmyard and chicken manure). Mthokozisi (2015) [18] also reported that no significant ($p>0.05$) effect of bioslurry on the plant height of cowpea when compared to other treatments (Mono-ammonium phosphate and control). The difference might be due to that plant growth beside to soil fertility affect by other factors such as season, genetic factors, climatic conditions, plant management and quantity of daylight.

Number of tillers per plant

There was a significant ($p<0.001$) effect between organic and inorganic fertilizer on number of tillers per plant of Rhodes grass (Table1). The maximum number of tiller (27.5) was obtained from T4 a mixing of 50% of bisulurry with 50% of NPS fertilizer and then followed T3 a sole of NPS and T2 a sole of bioslurry was given statistically similar tiller number, which produced 24.15 and 23.15 tiller numbers respectively. While the minimum tiller number (17.67) was observed from T1 control group (without added fertilizer).

The combination of bioslurry and NPS gave best

results regarding number of tiller per plant than control and sole NPS and sole bioslurry fertilizer applications. The reason might be due to integrated use of inorganic fertilizers with organic fertilizers is a sustainable method for efficient nutrient usage which enhances efficiency of the chemical fertilizers and also can improve the properties of soil Schoebitz, et al., (2016) [19]. Therefore, due to release of nutrients to plant at different time indicate enhanced development of new shoots and the development of new tillers.

The present finding is in line with the work of Yiberkew et al., (2020) [20]. It was reported that application of organic and inorganic fertilizers (NPS, Manure and control) significantly difference ($p<0.01$) with control group in number of tillers per plants of Brachiaria Hybrid Mulato II. Similar results have also been reported by Priyadarshan et al., (2013) [21] compost and inorganic fertilizer treatments had significant effect ($p<0.05$) in number of tiller per plants in the vetivar grass. The current finding disagrees with [22] who stated that at sole chemical fertilizer application observed maximum number of tillers per plant than combination of chemical and organic fertilizer and sole of organic fertilizer in oat grass. The average number of tiller (23.11) in the current study was higher than (18.2) earlier reports for the same grassby [7]. This difference might be associated to use application of combined fertilizer in the current study is attributed to more availability of nutrient both from NPS as well as bioslurry throughout the growing season and also related to weather, soil type and the management practices.

Number of leaves per plant

The different source of fertilizer application had significant ($p<0.001$) effect on number of leaves per plant of Rhodes grass. The maximum number of leaves per plant (173.05) were obtained from T4 where a mixing of 50% of bisulurry with 50% of NPS fertilizer. Among sole fertilizer application average number of leave was not significantly different between that of a sole of bioslurry at T2 (149.75) and a sole of NPS at T3 (148.22).While the minimum number of leaves per plant (86.1) was observed at T1 control group (without added fertilizer). The variation in number of leaves per plant might be due to the timely availability of nutrients from those different sources of fertilizers and also by the synergistic effects of Bioslurry and NPS fertilizers. This was probably due to the fact that, nitrogen increased plant growth and plant height and this resulted in more nodes and internodes and consequently more leaves. The nutrients required by plants have been released from different fertilizer types in different points of time that allowed the plant to develop plant parts accordingly.

The present finding is in line with the work of Yiberkew et al., (2020) [20]. It was reported that application of organic and inorganic fertilizers (NPS, Manure and control) significantly difference ($p<0.01$) with control group in number of leaves per plant of Brachiaria Hybrid Mulato II. Similarly, the significant value in the number of leaves per plant is in agreement with report of Biniyam et al., (2015) [15] who revealed that NPS fertilizer and manure significant affect number of leaves per plant of desho grass. This means application of fertilizer augment of number of leaves per plant than without fertilizer application of the experiment.

In contrast the current result disagree with Yossif and Yassin (2014) [17], who stated that number of leaves per plant of Rhodes grass was not significantly affected by different types of fertilizer (urea, farmyard and chicken manure).The difference might be due to nutrient availability of bioslurry much higher than other organic sources such as manure because of the digestion process improves nutrient content of bioslurry [27]. And also the current result disagreed with Mthokozisi (2015) [18] who repoted no significant ($p>0.05$) effect of bioslurry on number of leaves per plant of cowpea when compared to other treatments such as mono-ammonium phosphate and control.

Leaf length per plant

The application of different fertilizer had no significant effect on leaf length per plant of Rhodes grass, but there was significantly ($p<0.01$) difference from without fertilizer application (control group). The longest leaf length per plant (45.9 cm) was obtained from T4 where a mixing of 50% of bisulurry with 50% of NPS fertilizer and then followed by T3 alone of NPS and T2 alone of bioslurry which produce 43.92 cm and 43.5 cm leaf length per plant, respectively. The shortest leaf length per plant (37.37 cm) was observed at T1 control group (without added fertilizer).

The longest leaf length in bioslurry, NPS and mixing of the two fertilizer application might be supply enough nutrient to the grass but without added fertilizer limit of nutrient supplying to the grass. And also this variation in leaf length per plant might be due to the timely availability of nutrients from inorganic and organic source of fertilizers and uptake of essential nutrients might be attributed to synergic action of fertilizer. The current result is in line with Terefe et al., (2017) [7] who reported that Rhodes grass with application of fertilizer had significantly longest leaf length than non- fertilizer treatment ($p<0.01$). On the other hand the current result disagree with another report who stated that, there was a significantly ($p<0.01$) effect of organic and inorganic sources of fertilizers used alone or in combination on number of leaf length per plant in oat grass reported by Ahmad, et al., (20111) [22]. The leaf length of Rhodes grass by application of NPS (43.92) almost similar with bioslurry (43.5) fertilizer application in this study contrasted with the finding of Biniyam et al., (2015) [15] who reported thatthe highest mean leaf length per plant (LLPP) of desho grass observed at NPS fertilizer (29.89 cm) than manure. The reason might be due to difference nutrient composition between bioslurry and manure and also soil fertility.

Leaf to stem ratio (LSR)

The application of different fertilizer had no significant effect on leaf to stem ratio of Rhodes grass, but there was significantly ($p<0.01$) difference from without fertilizer application (control group).The range of overall observed LSR at different treatment were1.05 at control group to 1.21 at sole NPS, this indicate that availably of fertilizer increases leaf to stem ratio in some extent due to fertilizer stimulates new development of shoots that grow in to new leaf at harvesting date. The present finding is in line with Terefe et al., (2017) [7] who reported that Rhodes grass with application of fertilizer had significantly higher leaf to stem ratio than the control treatment ($p<0.01$). The average leaf to stem ratio (1.16) of Rhodes grass in the current study was higher than (1.09) earlier reports for the same species by Yassin (2014) [17]. The reason might be associated with differences in nutrient contents of fertilizer, weather, soil type and the management practices. Moreover, the current results agrees with reported by Brima (2007) [23], who stated that leaf to stem ratio of Rhodes grass was not significantly affected by different fertilizer application.

Effects of Different Fertilizer Types on Dry Matter and Seed Yield of Rhodes Grass

Forage dry matter yield

Dry matter yield is a measure of forage productivity. The effect of fertilizer type had significant ($p<0.001$) difference on the dry matter yield of Rhodes grass. The maximum dry matter yield (12.63 t/ha) was observed at T4 where a mixing of 50% of bisulurry with 50% of NPS fertilizer and followed that the application of NPS at T3 gave (11.83 t/ha) DM yield almost similar with biosulury at T2 (11.8 t/ha) which implies that bioslurry can substitute for NPS without affecting DM yield, whereas the minimum dry matter yield (7.69t/ha) was produced at T1 control group (without fertilizer) application, so a combination of bioslury with NPS, a sole of NPS and bioslurry resulted in increase in forage DM yield over control group. The mixed (bioslurry with NPS) fertilizer treatment produced a higher dry matter yield compared to bioslurry and NPS fertilizers alone, the reason might be due to that the application of only bioslurry nutrients release slowly and contribute to the residual pool of organic N and P in the soil, reducing N leaching loss and P fixation.

On the other side, only NPS fertilizers application, which in nutrients are soluble and immediately available to the plants; therefore the effect is usually direct and fast but nutrients are easily lost from soils through fixation, leaching or gas emission and can lead to reduced fertilizer efficiency. While the increase dry matter yield in combined application of 50% bioslurry and 50% chemical fertilizers application might be due to high level of microbial activity which enhanced organic matter decomposition as well as release of plant available nutrient and for dry matter yield of *Chloris gayana* grass associated with this bioslurry besides supplying nutrients, it also improve soil structure. Bioslurry application enhanced soil organic matter and soil nutrients, which were released slowly and steadily and efficiently utilized during later growth stages of Rhodes. The optimum yield obtained was attributable to that integrated use of inorganic and organic nutrient sources result into synergy, improved conservation and synchronization of

nutrient release and fertilizer efficiency and higher yields.

The result of the present study is agreement with that reported earlier by Fekadu et al., (2017) [24], it was reportedthat DM yield of the natural grassland was significantly affected ($p<0.01$) by the application of organic and inorganic fertilizer. Which chemical fertilizer increased DM yield by 65.3% and wood ash by 53.1%, whereas, cattle manure and lime increased by 49% and 42.1%, respectively compared to the unfertilized plot. The current finding agrees with Yassin (2014) [17], who stated that DMY of Rhodes grass was significantly affected by different types of fertilizer (urea, farmyard and chicken manure). The average DMY (11.04 t/ha^{-1}) of Rhodes grass obtained in this study was almost similar (11.19 t/ha^{-1}) at earlier reports for the same grass [7].

Seed yield

The seed yield of Rhodes grass between different fertilizer types and without fertilizer indicates there were significant ($p<0.001$) differences is shown in table 2.

Table 2. Effects of different fertilizer application on dry matter yield and seed yield of Rhodes grass

Treatments	Variables	
	DMY t/ha	SY Kg/ha
NPS	12.03^{b}	194.25^{a}
Bio-Slurry	11.80^{b}	193.03^{a}
Mix (NPS + Bio-slu)	12.63^{a}	199.30^{a}
Control	7.69^{c}	165.25^{b}
Overall mean	11.04	188
SEM	0.14	32.8
CV	3.41	3.04
R2	0.97	0.87
Sig	***	***

*=significant at 0.05; **=significant at 0.01; ***=significant at 0.001; means within column followed by the same letters are not significantly different; NPS=Nitrogen phosphatesulfur;SEM: standard error of the mean: CV=coefficient of varation; R2=coefficient of determination

The maximum seed yield (199.3 Kg/ha) was observed at T4 where a mixing of 50% of bisulurry with 50% of NPS fertilizer and T 2 biosulury and T3 only NPS where given statistically similar and which (193.03 Kg/ha and 194.25Kg/ha) respectively, whereas the minimum seed yield (165.9 Kg/ha) was produced at T1. The mean seed yield of Rhodes grass with application of Bioslury, NPS and a mix of bioslury with NPS was comparatively highest when compared to seed yields of unfertilized or controlled plot; this might be due to the application of different fertilizers that might be supply the required amount of nutrients timely and maintain the suitable condition to plants. When the grass getting enough nutrients from those types of fertilizer plant growth is fast and this is directly contributed to increase number of tiller means that there will be a large plant population it is possible to contribution of high seed yield. So, that proved that forage crops are responsive to fertilizers and the seed yield potential cannot be fully realized without fertilizers application.

The result of the present study agreed with that reported earlier by Getnet et al., (2011) [11] whose reported manure and nitrogen fertilization had a significant effect on average seed yields of Rhodes grass. It was reported that the highest seed yield 194.1kg/ha and 193.5 kg/ha at 92 kg/ha Nitrogen and 15 t/ha manure fertilizer application respectively; while, the lowest seed yield 145.8 kg/ha and 165.4 kg/ha at 23 kg/ha Nitrogen and control treatment or no fertilizer application respectively, average seed yield of Rhodes grass obtained in this study 188 kg/ha was higher than reported in the same grass (172.9 Kg/ha) by Getnet et al., (2011) [11]. This difference might be due to nutrient availability of bioslurry much higher than other organic sources and it might be the combination of organic and inorganic nutrient sources result into synergy, improved conservation and synchronization of nutrient release.

The present result agreed with Abate et al., (2020) [25] reported that fertilizer application had significantly higher seed yield than non-fertilizer treatment. It was reported that the highest seed yield was observed at application of 92 kg/ha NPS (467 kg/ha) which is significantly higher than non fertilizer treatment (294 kg/ha), but the average

seed yieldfor three consecutive years 405 kg/ha of this result higher than from the average (188 kg/ha) of current finding,the difference might be due to Rhodes grass is perennial so dry matter and seed yield in the second year might be double that of the establishment year [10].

Effects of Fertilizer Type on Forage Quality of Rhodes Grass

The results of organic and inorganic fertilizer application effect on forage quality of Rhodes grass are presented in Table 3.

Dry matter content (DM)

There was no significant difference ($p>0.05$) in terms of dry matter content of Rhodes grass (*Chloris gayana*) by different type of fertilizer application shown in Table 3.

Ash contents

The effect of different fertilizer type had significant ($p<0.001$) effect on the ash contents of Rhodes grass are shown. The highest ash content (11.81%) was observed at T4 where a mixing of 50% of bioslurry with 50% of NPS fertilizer and from T2 bio-slurry and T3 a sole of NPS application of fertilizer 10.81, 10.57 % ash content was obtained respectively. While the lowest ash (9.78%) content was observed at T1 control group (without fertilizer) applications. Increased ash content with application of combined fertilizer application than other treatments due to combination of organic and inorganic fertilizer application enhanced the phosphors and potassium uptake by plant than sole application [26].

Table 3. Effects of different fertilizer application on forage quality of Rhodes grass

Treatments	Variables						
	DM	ASH	CP	CPY	NDF	ADF	ADL
NPS	92.5^{a}	10.81^{b}	10.39^{b}	1.31^{ab}	65.44^{b}	53.26^{b}	11.55^{a}
Bio-slurry	92.5^{a}	10.57^{b}	10.23^{b}	1.20^{b}	64.40^{b}	52.44^{b}	11.03^{a}
Mix(NPS+Bio-slu)	92.0^{a}	11.81^{a}	11.25^{a}	1.42^{a}	65.07^{b}	52.98^{b}	11.42^{a}
Control	92.5^{a}	9.78^{c}	8.94^{b}	0.69^{c}	68.07^{a}	55.43^{a}	11.77^{a}
Overall mean	92.37	10.74	10.34	1.15	65.76	53.52	11.44
SEM	0.25	0.09	0.78	0.01	1.96	1.83	0.36
CV	0.54	2.80	8.59	8.70	2.13	2.52	5.30
R2	0.2	0.89	0.57	0.91	0.56	0.48	0.20
Sig	Ns	***	**	***	*	*	Ns

*=significant at 0.05; **=significant at 0.01; ***=significant at 0.001; means within column followed by the same letters are not significantly different; SE, standard error of the mean; CV= coefficient of varation; R2=coefficient of determination NPS=Nitrogen Phosphate and Sulfure

The present finding is in line with the work of Biniyam et al., (2018) [15]. It was reported that application of organic and inorganic fertilizers (NPS, Manure and control) significantly difference ($p<0.05$) in ash contents of desho grass. It was reported that the highest ash was 17.77 obtained at manure while the lowest 15.76 value was obtained at NPS fertilizer application [15], but the average ash content of 16.6 of this result higher than from the average current finding 10.74 ash content. The reason might be due to the nature of forage, different types of fertilizer, management system, soil and climatic conditions. According to Ahmad et al., (2011) [22], there was a significant effect of organic and inorganic sources of fertilizers used alone or in combination on ash contents in oat grass. The higher value of total ash obtained from chemical fertilizer application was significantly highest than poultry manure, farmyard manure and combination of chemical fertilizer and poultry manure. But this result disagreed with the present study; this difference might to nutrient availability of bioslurry much higher than other organic sources such as manure because of the digestion process improves nutrient content of bioslurry [27]. Avarege ash content of Rhodes grass obtained in this study (10.74) was much higher than that reported in the same grass (5.45) by Mabu Isa et al., (2019) [28]. This difference might be ash content in forages vary with soil fertility.

Crude protein content

Crude protein content (CP) is one of the most important parameters affecting the nutritional value of fodder crops. When choosing the appropriate forage to be grown, farmers should consider the need for protein for animal feed. Result showed that CP concentration of Rhodes grass was affected significantly by different source of fertilizers. All fertilizer application had significantly higher CP content than control treatment ($p<0.01$). The higher CP contents of Rhodes grass (11.25%) was observed at T4 where a mixing of 50% of bisulurry with 50% of fertilizer. Among sole fertilizer application mean CP percentage was not significantly different between that of sole of NPS at T3 (10.39%) and sole of bioslurry at T2 (10.23%). while the lowest CP (8.9%) content was observed at T1 control group (without fertilizer application). In general, the mean CP content of the Rhodes grass in the current study was higher than the critical value of 7% required for normal rumen microbial function and feed intake [29].

This assumption that high solubility and availability of the nitrogen in bioslurry, NPS and mixing of bioslurry and NPS fertilizer application, this nitrogen contributes greatly to synthesis of amino acids and ultimately proteins, the higher nitrogen available to the crops; the higher protein can be synthesized. It caused a significant increase in it and it might be due to the fact that continued supplied of nutrients to grass, allowed continuous sprouting of the vegetation, which was a bit fresh even during harvest of forage biomass. Lower CP in control groups was probably due to inadequate release of nitrogen, ast he amount of available nitrogen in the soil decreases, the plants rate of uptake cannot keep pace with their rate of growth. Bioslurry application alone and in combination with urea enhanced the nutrient uptake of plants [16].

This result is supported by Baghdadi et al., (2019) [14] who reported that CP concentration of corn-soybean forage was markedly affected by different fertilizer treatments. Combined application of chemical fertilizer and chicken manure Fertilizer application had significantly ($p<0.01$) higher mean CP percentages compared to 100% NPK, 100% chicken manure and control treatment. And also the present result agree with [30] who reported that there was a significant effect of organic and inorganic sources of fertilizers used on crude protein contents on degraded grazing land. It was reported that the highest CP was 15.74 obtained at cattle manure while the lowest 9.58% CP value was obtained at control group.

In contrast the current result disagreed with Yossif and Yassin (2013) [17] who showed that mean crude protein content was not significantly affected by different fertilizer type on Rhodes grass. This difference might be associated to use application of combined fertilizer more availability of nutrient result into synergy, improved conservation and synchronization of nutrient release also related to grass type, weather, soil type and the management practices.CP content of Rhodes grass obtained in this study (10.34) was lower than early reported in the same grass (11.78) by Yossif and Yassin (2013) [7]. This difference might be due to management system, nutrient contents of fertilizer, weather, and soil type.

Crude protein yield (CPY

The crude protein yield of Rhodes grass was affected significantly ($p<0.001$) by different source of fertilizers. The highest crude protein yield (1.42t/ha) was observed at T4 where a mixing of 50% of bisulurry with 50% of NPS fertilizer and among sole fertilizer application mean CPY was not significantly different between that of sole of NPS at T3 (1.31t/ha) and sole of bioslurry at T2 (1.2t/ha). While the lowest CPY (0.68 t/ha) content was observed at T1 control group (without fertilizer) application.

Therefore, the result indicated that, Bioslury, NPS and mixing of Bioslury and NPS fertilizer treatments contributed higher CPY content of Rhodes grass than the control group. This might be due to by influence of different types of fertilizer application has considerable effect on CP yield; the plants take up the bulk of nitrogen in growing season, which results in high CP content and dry matter yield, so that CPY is the product of total dry matter yield and CP concentration in the plant. Bioslurry application alone and in combination with urea enhanced the nutrients uptake of plants [16]. The current result, agree to the result of Yiberkew et al., (2020) [20]. It was reported that application of organic and inorganic fertilizers (NPS, Manure and without fertilizer) had significant effect ($p<0.01$) from without fertilizer in CPY of Brachiaria Hybrid Mulato II, the study also indicated that application of

fertilizer which improve soil nutrient results increase CP and biomass yield consequently higher CPY.

The CP yield of Rhodes grass under NPS and bioslurry applications in this study contrasted with the findings of Biniyam et al., (2018) [15] who reported thatthe highest mean crude protein yield was obtained at NPS (2.76 CP t/ha) which is significantly higher than manure(1.39 t/ha) the difference in the current study might be due to nutrient availability of bioslurry much higher than other organic sources such as manure because of the digestion process improves nutrient content of bioslurry [27]. The mean CPY (1.15 t/ha) of Rhodes grass in the current study was slightly lower than earlier reported by Yossif and Yassin (2013) [7] the same species, which result (1.22 t/ha). The difference might be due to different type of fertilizer application, management system, nutrient availability, soil and climatic conditions.

Neutral detergent fiber (NDF)

The NDF content of Rhodes grass between different fertilizer types and without fertilizer indicates there were significant ($p<0.05$) differences. Among different fertilizer application combination of 50% NPS and 50% Bioslurry, sole bioslurry and sole NPS 64.47, 65.07 and 65.44%, respectively, almost similar NDF content were obtained from different type of fertilizer application but they were significantly lower than from control group or without added fertilizer application (68.07%). The range of overall observed NDF content at different treatment was 64.47 to 68.07%. This might be due to the fact that different fertilizer improve the plant growth and raise new leaves and shoots than without fertilizer application, which minimize the NDF content of the grass, but it is less likely to produce a new leaves and tillers as sooner at non-fertilizer treatments as a result plant tissue matures and accumulate more NDF.

The result of the present study is lined with Baghdadi et al., (2019) [14] who reported that a combination of chemical and organic manure fertilizer application resulted in reduced NDF concentration of corn-soybean forage over without fertilizer application but similar with sole chicken manure treatment. The current finding is similar to Fekadu et al., (2014) [24] who reported that the effect of organic and inorganic fertilizer application on improvement of degraded grazing land of the grass by using fertilizer and manure to decrease NDF content for different grass species. Similarly, the current finding supported by Yiberkew et al., (2020) [20] who reported that application of organic and inorganic fertilizers (NPS, Manure and control) had significant effect ($P<0.05$) from control group in NDF content of Brachiaria Hybrid Mulato II.

In contrast the current result disagree with that reported by Rahman et al., (2016) [31], who reported NDF contents of Napier grass were not affected ($p>0.05$) by manure and urea fertilizer applications.And also the NDF content of Rhodes grass under NPS, bioslurry and mixing of two fertilizer applications in this study contrasted with the findings of Biniyam et al., (2018) [15] who reported that NDF content of desho grass was higher with manure than NPS fertilizer application, the difference in the current study might be due to nutrient availability of bioslurry much higher than other organic sources such as manure so, bioslurry can substitute for NPS without affecting quality of Rhodes grass.

Acid detergent fiber (ADF)

The ADF content of Rhodes grass at different fertilizer types and without fertilizer indicates there were significant ($p<0.05$) differences. Among different fertilizer application of NPS, bioslurry and mix of 50% NPS & 50% bioslurry ADF concentration was not significantly different between that of NPS (53.26%), bioslurry (52.44%), and mix of 50% NPS & 50% bioslurry (52.97%) but they were significantly lower than control group or without added fertilizer application (55.43%). This might be due to the fact that fertilizer application improves the plant growth and raise new leaves and shoots, which minimize the ADF content of the grass, but it is less likely to produce a new leaves and tillers as sooner at non-fertilizer treatments as a result plant tissue matures and accumulate more ADF. The range of overall observed ADF content at different treatment was 52.44 to 55.43%. The ADF content range (52.44% to 55.43%) obtained in the present study was within the favorable range of 33.3 to 59.40% which is considered as medium quality roughages [32]. The present finding supported by Baghdadi et al., (2019) [14] who reported the ADF concentration of soybean forage with application of chicken manure and NPK produced lower ADF concentration than without fertilizer

treatment.Similarly the current result agreed with Fekadu et al., (2014) [24] the application of different type of fertilizer significantly affect ($p<0.05$) the ADF content of natural pasture, in which the highest ADF 43.3% was obtained when no fertilizer application and the lowest ADF 39.65 at cattle manure, but the average ADF (41.5%) of this result lower than from the current finding (53.5%) ADF. The reason might be due to in natural pastures different botanical composition there is appropriate grass-legume combination because this would maintain the soil micro-organisms, particularly rhizobial bacterial.

Acid detergent lignin (ADL)

The effects of different fertilizer application had no significant ($p>0.05$) effect on ADL content of Rhodes grass is shown in table 3.

4. Conclusions

The present study showed that most of the morphological characteristics, DMY and forage quality parameters of Rhodes grass were significantly ($p<0.05$) affected by different fertilizer type. The combination of 50% bio slurry with 50% NPS fertilizer was produce better morphological, DMY, seed yield and forage quality than other treatments in Rhodes grass and the effects of a sole of bioslurry and sole NPS fertilizers were almost similar result in all parameters which implies that bioslurry can substitute for NPS without affecting overall performance of Rhodes grass, but the results were less than from combination of 50% bio slurry and 50% NPS mix fertilizer. Therefore, application of NPS, Bio-slurry and the combination of the two fertilizers can improve the yield and quality of the Rhodes grass. Bio-slurry fertilizer is locally available hence smallholder farmers living in the rural area with low income who do not have the capacity to afford chemical fertilizer as per the recommend rate can easily afford it as compared to expensive chemical fertilizer.

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