Asian Journal of Research and Review in Agriculture

Volume 6, Issue 1, Page 161-170, 2024; Article no.AJRRA.1562

Effect of different Chicken Manure Rates on Yield and Quality of Sudan Grass (*Sorghum sudanense* Piper.)

Feisal M. Ismaeil [a*], Salah Eldeen E. Ahmed [a], Abderhim A. Jabereldar [a], Entisar Elilah B. Mohammed Ahmed [a] and Mohammed H. B [b]

[a] Department of Crop Science, Faculty of Natural Resources and Environmental Studies, University of Kordofan, ElObeid, Sudan.
[b] Department of Animal Production, Faculty of Agriculture, Dalanj University, Sudan.

Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

Article Information

Open Peer Review History:
This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: https://prh.globalpresshub.com/review-history/1562

Original Research Article

Received: 12/02/2024
Accepted: 16/04/2024
Published: 25/04/2024

ABSTRACT

The present study was carried out at the Experimental Farm of the Department of Crop Science, Faculty of Natural and Environmental Studies, University of Kordofan, ElObeid, Sudan. To investigate the effect of different levels of chicken manure on growth, yield and quality of Sudan grass forage (*Sorghum sudanense*). The treatments consisted of four levels of chicken manure: control, 1.5, 3 and 6 ton/ha (CH0, CH1, CH2 and CH3). The treatments were arranged in a Randomized Complete Block Design (RCBD) with four replications. The characters measured were: plant population, plant height (cm), number of leaves/ plant, fresh weight (ton/ha), dry weight (ton/ha), crude protein (%) content, fiber (%) content and carbohydrates (%) content. the results showed that there were significant differences among the treatments in most parameters under

**Corresponding author: E-mail: feisal_musa891@yahoo.com;*

study. Chicken manure increased growth characteristics as well as forage yield. Chicken manure rate (6 ton/ha) produced higher fresh and dry forage at harvest compared to the other treatments. Also the results demonstrated that chicken manure significantly increased the percentage (%) content of crude protein and carbohydrates while decreased fiber percentage (%) concentration compared to the control. The treatment 6 ton/ha (CH3) had highest values of protein (14.12) and carbohydrate (52.74) (%) content, while the lowest values (9.97and 44.59) % content respectively, were recorded in the control. Then, based on these results we recommended that to obtain high growth, forage yield and quality from Sudan grass forage chicken manure at the rate of (6 ton/ha) should be applied.

Keywords: Chicken manure; growth; yield; quality; Sudan grass.

1. INTRODUCTION

"The utilization of fodder crop has increased in last years to meet the increasingly demand for animal products for both local consumption and export]" [1]. "Forage production developed intensively in the new area. Sudan grass (*Sorghum sudanense*) is a promising fodder crop that can be cultivated under irrigation. Recently policies to incorporate forage crops in the irrigated agricultural schemes rotation of the Sudan have initiated some minor investigate activities" [2]. "Sudan grass is a tropical fodder crop with high-quality nutritive value, the crop is not broadly known, it is only found in limited areas along the River Nile in the central and Khartoum States. Sudan grass is a different type of forage which was considered one of the commonly used as summer forage crops in the subtropical areas of the world. The crop is extremely leafy with very fast regrowth after grazing or cutting" [3]. "Sudan grass is a drought tolerant fodder crop" [4]. "Sudan grass is suitable for regions with warm or hot dry summer and has little uses in humid tropics". [1] The crop flowering a round two months from planting [5] and its herbage and high in crude protein. According to Farhoomand and Wedin [6], "the average of crude protein concentration of Sudan grass in the herbage is about 12% while; young plants contain up to 16% crude protein. The crude fiber concentration of the crop is not exceeds 30%".

"The increasing demand of chicken meat in Sudan has encouraged more poultry farming with resulting effects on increased use of organic wastes such as chicken manure as fertilizers. Organic wastes include different amounts of mineral nutrients, water, organic matter". [7] Whereas the use of organic wastes as manure has been applied for many centuries world-wide [8] and in the recent times [9,10], there still exists a need to evaluate the potential effects of chicken manure on crop production and in particular assess the critical application doses. "Moreover, the need and utilization of chicken manure has overtaken the utilized of other animal manure, because of its high concentration of nitrogen, phosphorus and potassium" [11]. "Also, organic wastes are similarly being advocated for by different environmental organizations world-wide to conserve the sustainability of agricultural systems. Moreover, chicken manure is preferred among other animal wastes since of its high content of macro-nutrients" [12,13,14]. Chescheir et al. [15] recorded that "increase in nitrogen rates from 40 - 60% and 17 - 38% with respect to control for Cecil sandy loam soils and Norfolk sandy soils, respectively following use of manure. Additionally, a chicken manure application to soil improves water soluble salts concentration in soil". "Plants absorb plant nutrients in the form of soluble salts, but excessive soluble salts accumulation (or soil salinity) enhances plant growth" [15]. Stephenson et al. [16], found that "the EC of chicken manure of about 11 dS/m in silt loam soils too high for salt stress sensitive crops". The dry chicken manure pH pellets was establish to be 7.9, with most of the nutrients existing in this environment [11] whereas a reduce in the soil pH (< 6.5) affects the nutrients availability to plants [13].

The study aims to examine the impact of fertilizer uptake on the growth and yield of sudan grass. Additionally, it compares the effects of varying levels of chicken manure on the growth, yield, and quality of sudan grass. Finally, it determines the ideal level of chicken manure that yields the highest possible yield and superior quality of forage.

2. MATERIALS AND METHODS

2.1 Experimental Site

Afield experiment was conducted at the Experimental Farm of Department of Crop

Science, Faculty of Natural Resources and Environmental Studies, University of Kordofan, El-Obeid, Sudan, during the period (February-May 2023) to study the effect of different levels of chicken manure on growth, yield and quality of sudan grass. The site is located in the arid and semi arid (latitude 11 - 15 and 16 - 30 N and longitude 27 - 32 E). The soil of experimental site is sandy its coarse textured until 50 cm depth, very low nutrients and poor water holding capacity, which makes it hard for the plant's roots to absorb water, annual rain fall is about 350 - 450 mm [17], and maximum daily temperature is about 30 - 50 Cº throughout the year.

2.2 Experimental Design

The treatments in this study consisted of four levels of chicken manure namely (0, 1.5, 3 and 6 tons/ha) designated as (CH0, CH1, CH2 and CH3). The treatments were arranged in a Randomized Complete Block Design (RCBD) with four replications. Seeds of sudan grass used in this experiment were obtained from the local market. Fertilizer used was chicken manure, which was collected from a poultry farm of Department of Animal Production. Manure was fermented before use to eliminate all weed seeds and pathogens

The fertilizer was applied on 25/2/2023 broadcasted manually on the bottom of the ridges mixed with soil and distributed equally to the entire plot by a hand hoe and after that irrigated immediately until day ten. Sowing was done manually on one side of the ridge (eastern side of ridge) and it was done on March 7th 2023. The seed rate applied was 40 Kg/ha.The experimental site was plot leveled and ridged into 70 cm. The size of each experimental unit was 5 x 5 meters consisting of 6 ridges of 5 meters in length. In each plot, 2nd and5th ridges were used for sampling. The spaces between experimental units were one meter and between replications was two meter. The crop was irrigated immediately after sowing and then at 5 -7 day intervals according to the crop needs. Each plot was irrigated separately to avoid chicken manure movement to adjoining plots. The experimental plots were weed free by hand weeding.

2.3 Characters Measured

2.3.1 Plant population

An area of one-meter row (0.7m^2) was permanently marked in each treatment in one of the two middle ridges. Plants were calculated after 10, 30 days after sowing, and at harvest.

2.3.2 Plant height (cm)

Plant height was measured as an average height of five plants per plot at the 15, 45 days after sowing and at harvest taken from the soil surface to the tip of the flag leaf.

2.3.3 Number of leaves/ plant

It was obtained by calculating all leaves of five randomly selected plants after 15, 45 days after planting and at harvest and then the average number of leaves per plant was determined.

2.3.4 Fresh forage yield (ton/ ha)

At the harvest the entire plot (0.7 m^2) for each treatment was clipped by A sickle, weighted immediately by a spring balance in the field to get the fresh weight. Final fresh yield was measured in ton per hectare.

2.3.5 Dry forage yield (ton/ ha)

The fresh forage sample taken from each plot (0.7 m^2) for each treatment was left to dry in an oven at 80 ^{0}C for 36 hours until a constant weight was reached then final dry yield was measured in tons per hectare .

2.4 Forage Quality Parameters

samples of quality characteristics were taken from leaves and stem when it was oven dried for 2 days at 80 ^{0}C, were calculated for all samples after drying and grinding the samples were ground to small portion then mixed together to be utilized in chemical analysis.

2.4.1 Protein percentage (%)

The % of nitrogen was measured by micro Kjeldal apparatus using the method of A. O. A. C. [18]. Protein (%) was calculated using the following equation:
Protein (%) = Nitrogen (%) × 6.25

2.4.2 Fiber percentage (%)

Was determined according to procedure outlined by A. O. A. C. [19] using the following formula:-

Crude fiber (%) = 100* A-B / C

Where:

A = weight of crucible with dry residue (g)

B = weight of crucible with ash (g)
C = weight of sample (g)

2.4.3 Total carbohydrates percentage (%)

After the calculation of the protein, fiber, ash and ether extracts percentage the percentage of the total carbohydrates was measured according to A. O. A. C. [20] using the following equation:

Total carbohydrates (%) =100-(ash (%) + fiber (%) + protein (%) + ether extracts (%).

2.5 Statistical Analyses

Data were collected and analyzed using analysis of variance (ANOVA) and SPSS (SPSS Inc, Chicago, IL). Significant different means of the measured data were separated at the 0.05 probability level by the Least Significant Different (LSD).

3. RESULTS

3.1 Effect of different Chicken Manure Levels on Growth Attributes

3.1.1 Plant population

Effect of different chicken manure levels on plants density of sudan grass is shown in table (1). Number of plants per unit area (0.7 m^2) demonstrated a stable increase with time, regardless of treatment used, up to second counting occurrences. Then, a drop in number of plants per unit area was observed (count 3 Table 1). The results demonstrated significant differences among the treatments for number of plants per unit area. Chicken manure significantly increased the number of plants per unit area compared to the control during different sampling occasions. The highest number of plants/m2 62.25, 66.5 and 56.16 in the first, second and third counting, were obtained at the chicken manure rate of 6 ton/ha, whereas the lowest number of plants/m2 were obtained at control, which gave 44.75, 47 and 41 plants/m2 in the first, second and third counting, respectively.

3.1.2 Plant height

Plant height data illustrates significant differences among the different chicken manure treatments (Table 2). Plants fertilized with various chicken manure levels were significantly taller than those of the control. In addition, 6 ton /ha of chicken manure treatment resulted the tallest plant followed by 3 ton/ha, 1.5 ton/ha treatments and the control, which resulted in the shorter plants.

3.1.3 Number of leaves/ plant

The effect of different chicken manure levels on number of leaves / plant of sudan grass is shows in Table 3. Significant differences for CH3 and CH2 of chicken manure levels treatments over the control were obtained for the trait throughout the first, second and third count, the number of leaves per plant significantly increased under chicken manure treatments. The CH3 (6 ton chicken manure/ha) gave higher number of leaves per plant in the different counting occasions compared to other treatments.

3.2 Effect of different Chicken Manure Levels on Yield Attributes

3.2.1 Fresh forage yield

Effect of different chicken manure levels on fresh forage yield of sudan grass is shown in Fig. 1. The results showed that there were significant differences among the treatments in the forage fresh yield. All chicken manure treatments resulted in higher fresh yield compared to the

Table 1. Effect of different chicken manure levels on number of plants / m^2 at different counts during growing season of sudan grass

Treatments	1 st count at 10 days	2 nd count at 30 days	3 rd count at harvest
CH0	44.75d	47d	41d
CH1	51.15c	54c	45.21c
CH2	54.75b	57.73b	50.52b
CH3	62.25a	66.5a	56.16a
LSD	2.07	2.12	1.50
CV%	4.67	8.19	9.43
SE±	0.80	0.82	0.58

Different small letters in the same column refer to significant differences between treatments at P < 0.05 level of probability

Table 2. Effect of different chicken manure levels on plant height (cm) at different sampling during the growing season of sudan grass

Treatments	1 st sampling at 15 days	2 nd sampling at 45 days	3 rd sampling at harvest
CH0	30.84d	113.88d	128.74d
CH1	35.40c	123.95c	144.58c
CH2	39.54b	129.45b	152.86b
CH3	42.61a	135.08a	158.72a
LSD	3.11	1.82	2.08
CV%	6.46	7.37	5.95
SE±	1.20	0.70	0.80

Different small letters in the same column refer to significant differences between treatments at P < 0.05 level of probability

Table 3. Effect of different chicken manure levels on number of leaves/plant at different counts during growing season of sudan grass

Treatments	1 st count at 15 days	2 nd count at 45 days	3 rd count at harvest
CH0	6.25c	7.11d	7.73d
CH1	7.67b	8.65c	9.15c
CH2	8.98a	9.23b	10.72b
CH3	9.73a	10.75a	11.82
LSD	1.37	1.12	1.02
CV%	9.36	9.27	4.72
SE±	0.53	0.65	0.39

Different small letters in the same column refer to significant differences between treatments at P < 0.05 level of probability

control (Fig. 1). On the other hand, the chicken manure level CH3 (6 ton /ha) scored the highest yield compared to the control followed by CH2 (3 ton /ha) and CH1 (1.5 ton/ha).

3.2.2 Dry forage yield

Fig. 2 demonstrated that there was significant different on dry forage yield between chicken manure fertilizer treatments and the control. On the other hand, all treatments had a significantly higher dry yield (ton/ ha) when compared to the control (Fig. 2). Chicken manure level (6 ton/ha) resulted in the highest dry yield, followed by (3 ton/ha) and (1.5 ton/ha).

3.3 Effect of different Chicken Manure Levels on Quality Attributes

3.3.1 Protein (%)

The results of Fig. 3 showed that the percentage of crude protein contents increased with increasing the rate of chicken manure. Plants fertilized with (6 ton/ha) of chicken manure demonstrated highest crude protein (%)) (14.12) which was considerably higher than all other treatments, and lowest value was obtained in control (9.97) crude protein (%).

3.3.2 Fiber percentage (%)

As shown in Fig. 4, all chicken manure treatments significantly reduced the fiber percentage (%) compared to the control. On the other hand, the results of chicken manure treatments showed that 6 ton/ha recorded lowest fiber (%) (19.05) and the highest value were obtained in control (23.75) fiber (%).

3.3.3 Carbohydrate percentage (%)

Fig. 5 showed that there were significant differences between the chicken manure treatments for carbohydrate percentage (%) when compared to control. The results showed that carbohydrates content was highest in 6 ton/ha (52.74) percentage (%) where the lowest was obtained in control CH0 (44.59) carbohydrate (%).

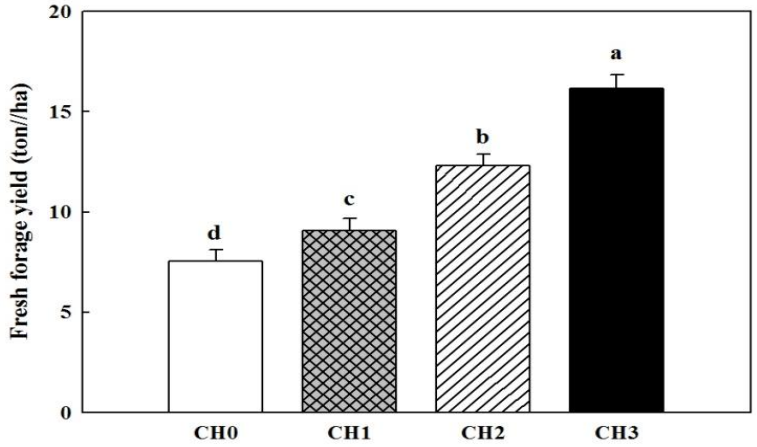

Fig. 1. Effects of different chicken manure levels on forage fresh yield in sudan grass
Data are mean +SD (n=3). Different small letters indicate significant differences between treatments at P < 0.05

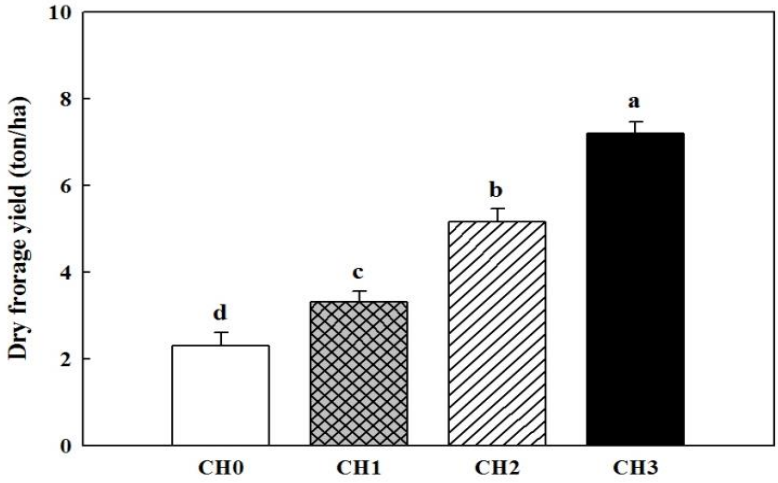

Fig. 2. Effects of different chicken manure levels on forage dry yield in sudan grass
Data are mean +SD (n=3). Different small letters indicate significant differences between treatments at P < 0.05

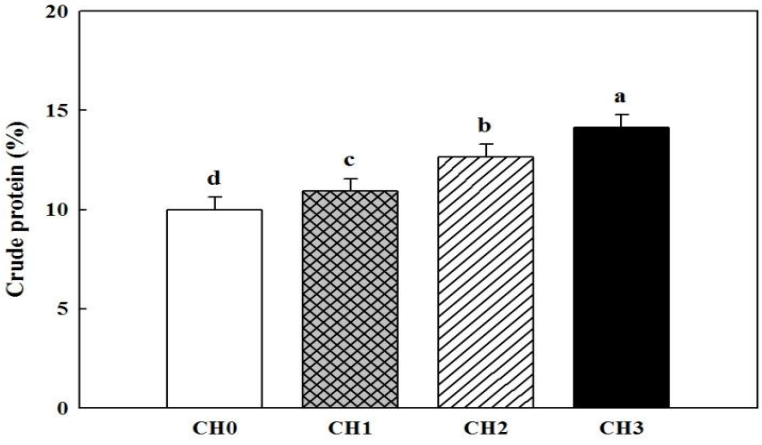

Fig. 3. Effects of different chicken manure levels on crude protein (%) in sudan grass
Data are mean +SD (n=3). Different small letters indicate significant differences between treatments at P < 0.05

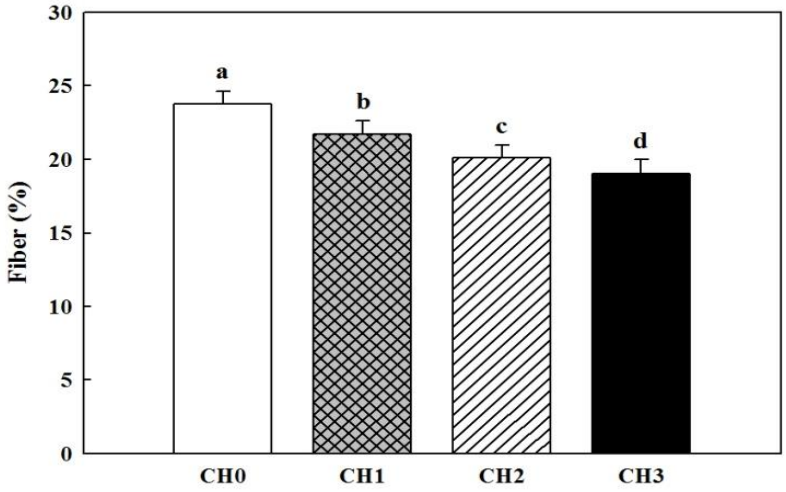

Fig. 4. Effects of different chicken manure levels on fiber (%) in sudan grass
Data are mean +SD (n=3). Different small letters indicate significant differences between treatments at P < 0.05

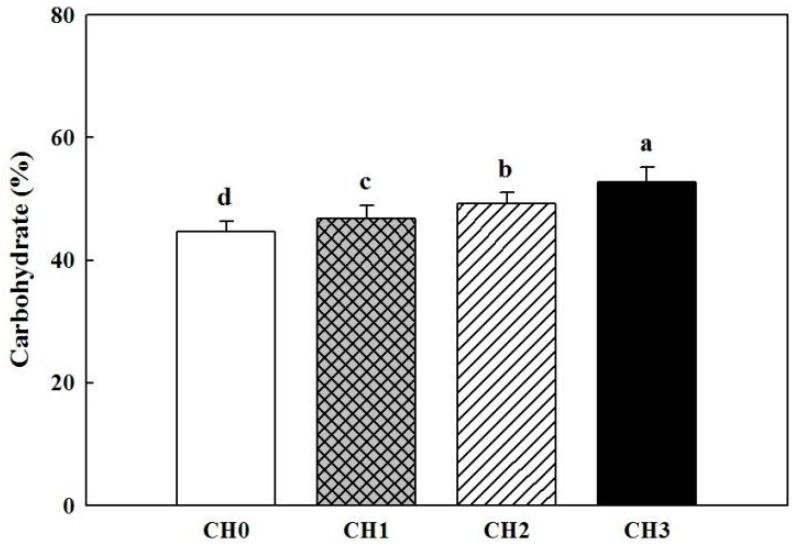

Fig. 5. Effects of different chicken manure levels on carbohydrate (%) in sudan grass
Data are mean +SD (n=3). Different small letters indicate significant differences between treatments at P < 0.05

4. DISCUSSION

In this present study, the growth attributes of sudan grass studied were plant population, plant height, number of leaves per plant. “The change in these parameters is very considerable aspect for forage production, because they are vegetative characteristics that contribute herbage yield components. The treatments of chicken manure scored higher number of plants population, taller plants, and higher number of leaves per plant and increased the yield of fresh and dry matter of sudan grass forage compared to the control. These responses may possibly refer to its high concentration of nitrogen, phosphorus and potassium” [12]. “Fertilization proposes that this crop as it is non – leguminous, may have obtained high supply of nitrogen from the soil directly. Another elucidation may by attributable to the effect of chicken manure on soil fertility (chicken manure re-established soil fertility)” [8]. This is in agreement with that mentioned by [21] who found that “potential utilizes for poultry manure as a fertilizer and soil amendment”. Conversely, [22] found that “poultry litter contains a substantial amount of organic

matter, so have an influence on soil pH and liming due to different amount of calcium carbonate in poultry feed". Elamin [23], reported that "decomposition of organic matter enhanced the soil physical and chemical proprieties. The nitrogen source from chicken manure gave taller plants because nitrogen was found to enhance number of nodes as well as inter node length and as a result plant height. Chicken manure CH3 (6 ton/ha), scored taller plants than the control". This is conformity with that [24] who found that "chicken manure fertilizer significantly increased plant height. Higher level of chicken manure (6 ton/ha) significantly improved a number of growth attributes of sudan grass than the control". On the other hand, this in agreement with Hassan [25], who mentioned that "chicken manure resulted in an increase in growth parameters as well as forage yield of sorghum fodder Abusabien compared to the control". A comparable result was obtained by Sanni [26], who found that "cattle manure increased growth of (Amaranthus hybridus). All the fertilized treatments scored higher leaves number per plant than the control, with higher value for the highest chicken manure rate (6 ton chicken manure/ha). It is clear that in our present study the number of plants per unit area were increased with time but the number reduced by third count. This probably attributing to fact that mortality of plant with time attributable to competition between plants for growth requirements and thus only stronger ones can survive".

Forage yield in terms of fresh and dry matter was examined in this study. Forage yield is always related to growth characteristics. Chicken manure resulted in enhance in growth parameters as well as forage yield. Chicken manure CH3 (6 ton/ha) produced higher fresh and dry forage than the control. This is in agreed with Hassan [24] who reported that "the highest yield of both Abu Sabien and pioneer 988 was scored with (7.5 tons/ton) chicken manure treatment whereas the lowest was obtained with the control". This result was expected since chicken manure contains nitrogen that certainly increased growth. Abusuwar and Zilal [8], found that "Chicken manure levels considerably influenced forage fresh and dry yields. The highest fresh and dry matter of forage yield was obtained under the highest level of manure applied". Similar finding was outlined by Sanni [27] who found that cow manure improved forage yield of sudan grass Numerous researchers [28,29] mentioned that nitrogen and phosphorus uptake, as a function of chicken manure application doze, increased steadily with increasing manure doze.

The results in this research were in conformity with Afzal et al. [30] who mentioned that the most significant factors affecting the nutritional value of forage crop is protein concentration. The maximum crude protein content was obtained in (6 ton/ ha) of chicken manure, while the lowest crude protein content was found in (0 ton/ ha) of control. Significant differences for crude protein concentrations amongst the sorghum cultivars recorded by Neylon et al. [31], [32] who found that nitrogen fertilizer significantly increased the crude protein concentration (%). Our results also confirmed that the protein content was increased under chicken manure treatments as a source of nitrogen compared to the control. The increase in protein content with increasing the nitrogen doze might be due to nitrogen enhancing the formation of amino acid and so increasing protein concentration. Reddy et al. [33], carried out an experiment established that the nitrogen had a significant influence on the neutral detergent fiber. The highest content of neural detergent fibers was obtained in the control, and it decreased with increased in nitrogen level. In this study, chicken manure containing nitrogen obviously reduced the fiber percent content as compared to the control. As a result, it illustrates that use of nitrogen fertilizer improves sweet sorghum forage quality due to a decrease in fiber concentration, as has also been mentioned by Almodareset al. [34]. AL-Janabi and AL-Fahdawi [35], described that nitrogen fertilizer had a significant impact on carbohydrate percentage increases. Our results also showed that the application of chicken manure (nitrogen contain) increases carbohydrate percentage content. [30], reported that application of nitrogen fertilizer to sorghum crops improve forage quality.

5. CONCLUSIONS

The results of this study obviously confirmed that chicken manure increased the growth characteristics as well as forage yield (fresh and dry). Quality characters protein, fiber and carbohydrate significantly influenced by nitrogen. There more, CH3 (6 ton/ha of chicken manure) registered highest growth parameters, increased forage yield and enhanced forage quality. Based on these findings, it is recommended that chicken manure at rate of 6 ton/ha should be used. More future exploring study with different levels of nitrogen is recommended.

ACKNOWLEDGEMENTS

We would like to thank the all staffs at the department of Crop Science, Faculty of Natural Resources and Environmental Studies, University of Kordofan, El-Obeid, Sudan, for preparing the field and equipments during the study.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Suleiman SY, Najmaldin, Abaker M Malik, Gangi S Ali. Effect of seed rate and nitrogen fertilizer on forage yield of sudan grass (Sorghum Sudanense "Piper" Stapf) In Central Sudan. International Journal of Innovative Research and Advanced Studies. 2019;6(4):195-200.
2. Hassan SE. Effect of nitrogen and phosphorus fertilization on seed yield of sudden grass. M.SC. Thesis. University of Gezira, Faculty of Agricultural Sciences, Wad Medani, Sudan; 2005.
3. Ross SM, King JR, Spaner D. Intercropping berseem clover with barley and oat cultivars for forage. Agron. J. 2004;96:1719-1729.
4. Eneji AE, Inanaga S, Muranaka S, Li JT, Hattori JT, An P, Tsuji W. Growth and nutrient use in four grasses under drought stress as mediated by silicon fertilizers. J. Plant Nut. 2008;31:355-365.
5. AL-Bakri MM, Ibrahim AES, Gangi AS. Forage yield potential of Sudan grass and Cowpea irrigated mixtures in Central Sudan. Gezira Journal of Agricultural Science. 2003;1(2):94-110.
6. Farhoomand MB, Wedin WF. Change in composition of Sudan grass and forage with maturity Agronomy Journal. 1968;60: 459 -466.
7. Ismaeil FM, Abusuwar AO, El Naim AM. Influence of chicken manure on growth and yield of forage sorghum (*Sorghum bicolor L. Moench*). International Journal of Agriculture and Forestry. 2012 Nov 28;2(2):56-60.
8. 7.Abusuwar AO, El Zilal HA. Effect of chicken manure on yield, quality and HCN concentration of two forage Sorghum (*Sorghum bicolor* (L) Moench) cultivars. Agric. Biol. JN Am. 2010;1(1):27-31.
9. 8. Gambara P, Machemedze T, Mwenye D. Chihota soil fertility Project, Annual Report 1998 to 1999. Unpublished report, AGRITEX, Marondera Zimbabwe; 2000.
10. López- Masquera ME, Cabaleiro F, Sainz MS, López- Fabal A, Carral E. Fertilizing value of broiler litter: Effects of drying and pelletizing. Bioresource Technol. 2008;99: 5626-5633.
11. Amir Aziz1, Bilal Ahmad Khan, Mukkram Ali Tahir. Effect of poultry manure on growth and yield of forage sorghum (*Sorghum bicolor* L.). International Journal of Botany Studies. 2020;5(3):401-406
12. Warman PR. The effect of fertilizer, chicken manure and dairy manure on Timothy yield, tissue composition and soil fertility. Agric.Wastes. 1986;18:289-298.
13. Duncan J. Composting chicken manure. WSU Cooperative Extension, King County Master Gardener and Cooperative Extension Livestock Advisor; 2005.
14. Oagile D and Namasiku M. Chicken manure-enhanced soil fertility and productivity: Effects of application rates. Journal of Soil Science and Environmental Management. 2010;1(3):46-54.
15. Chescheir PW, Westserman LM, Safley Jr LM. Laboratory methods for estimating available nitrogen in manures and sludges. Agric. Wastes. 1986;18:175-195.
16. Stephenson AH, McCaskey AT, Ruffin BG. A Survey of broiler litter compositio and potential value as a nutrient resource. Biol.Wastes. 1990;34:1-9.
17. Ahmed AA. Effectiveness of screening and Hardening Methods for Drought Resistance in Sorghum Genotype (*Sorghum bicolor* (L) *Moench*), Evaluated under Arid Conditions, PhD Thesis of Agronomy. Gazeira University. Sudan; 2009.
18. AOAC. Association of Official Analytical Chemists and Association of Official Agricultural Chemists (US. Official methods of analysis. 1980;13.
19. AOAC C. Xanthophylls in Dried Plant Materials and Mixed Feeds. Method 970.64. Official Methods of Analysis of the Association of Official Analytical Chemists, 15th ed., Association of Official Analytical Chemists, Inc. Arlington, VA, USA. 1990; 1048-1049.
20. A. O. A. C. Association of Official Agricultural Chemists and Horwitz W, Official methods of analysis. Washington,

DC: Association of Official Analytical Chemists. 1975;222.
21. Bendfeldt. Poultry litter as fertilizer and soil Amendment. Associate Extension Agent, Agricultural and Natural Research, R.A. Clark, Extension agent, Agriculture and natural resources; 2002.
22. Mullins LG. Poultry litter as a fertilizer and soil amendment. Crop and soil Environmental science and ES, Bendfeldt associate extension agents Agricultural and natural resources R.A. Clark Extension Agent, Agriculture and Natural Resources, Virginia Tech. Publication number 424-534 posted January; 2002.
23. Elamin EE. Effect of Organic Manure Decomposition on Some Soil Properties. M.Sc (Agric). Thesis, Faculty of Agriculture, University of Khartoum; 1991.
24. Hassan EAH. Effect of chicken manure and season on the performance and HCN Content of two Forage sorghum cultivar, Ph.D. Thesis, Faculty of Agriculture, University of Khartoum, Sudan; 2002.
25. Feisal M. Ismaeil, Awad O. Abusuwar, Ahmed M. El Naim. Influence of Chicken Manure on Growth and Yield of Forage Sorghum (*Sorghum Bicolor L. Moench*). International Journal of Agriculture and Forestry. 2012;2(2):56-60.
26. Sanni KO. Effect of compost, cow dung and NPK 15-15-15 fertilizer on growth and yield performance of Amaranth (*Amaranthus hybridus*). International Journal of Advances in Scientific Research. 2016;2:076-082.
Available:https://bit.ly/3kUwqL0
27. Awad O. Abusuwar. Effect of fermented manures on intercropped Sudan grass (*Sorghum sudanese* L.) and clitoria (*Clitoria ternata*) growth in an arid saline environment. The Journal of Animal and Plant Sciences. 2019;29(1):269-277.
28. Khan HZ, Malik MA and Saleem H. Effect of rate and source of organic material on the production potential of spring maize (*Zea mays* L.). Pak J AgriSci. 2008;45:40-43.
29. Hue NV, Sobieszczyk BA. Nutritional values of some bio-wastes as soil amendments. Compost Sci. Utilization 7:34-41. CAB Abstracts, 98/2000; 1999.
30. Afzal M, Ahmad A, Ahmad AH. Effect of nitrogen on growth and yield of sorghum forage (*Sorghum bicolor (L.) Moench CV*.) Under three cuttings system. Cercetări Agronomice in Moldova. 2012;45(4):57-64.
31. Neylon JM, Ebling TL, Taylor CC, Lynch MP, Reddish MA, Endres MI, Kung L. The effects of height of cutting, hybrid, and stage of maturity at harvest on the nutritive value of corn silage for lactating dairy cows. J. Dairy Sci. 2002;85(Suppl 1):383.
32. Reddy SS, Shivaraj B, Reddy VC, Ananda MG. Direct effect of fertilizers and residual effect of organic manures on yield and nutrient uptake of maize (*Zea mays* L.) in groundnut-maize cropping system. Crop Research-Hisar. 2005;29(3):390.
33. Mohammed MI, Zakaria ZA. Quality attributes in Sudanese sorghums improved for forage yield. American Journal of Experimental Agriculture. 2014;4(2):171.
34. Almodares A, Jafarinia M, Hadi MR. The effects of nitrogen fertilizer on chemical compositions in corn and sweet sorghum. American- Eurasian Journal of Agricultural and Environmental Sciences. 2009;6(4): 441-44.
35. AL-Janabi MAA, AL-Fahdawi BAS. Effect of some levels of Nitrogen fertilizer and Cutting dates in some quality traits on green forage of *Sorghum bicolor L*. Tikrit Journal for Agricultural Sciences. 2014;14(2).

© Copyright (2024): Author(s). The licensee is the journal publisher. This is an Open Access article distributed under the terms of the Creative Commons Attribution License (http://creativecommons.org/licenses/by/4.0), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Peer-review history:
The peer review history for this paper can be accessed here:
https://prh.globalpresshub.com/review-history/1562