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EFFECT OF IRRIGATION VOLUME, FREQUENCY AND NATRON (*KANWA*) ON CHEMICAL COMPOSITION OF ROUND-LEAF CASSIA (*Chamaecrista rotundifolia Cv.* Wynn) IN NIGERIAN SAVANNA

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Abstract

A study was conducted to evaluate the effects of varying levels of irrigation volume, irrigation frequency and Natron (*Kanwa*) on chemical composition of *Chamaecrista rotundifolia* forage. The experiment was laid out in a split plot with 3×2×2 factorial arrangement, with three replications. Results indicated that the crude protein, ether extract and ash increased ($P<0.05$) by 23%, 27% and 16% respectively, while N, P and K increased ($P<0.05$) by 27%, 60%, and 71% respectively at 8 weeks after sowing in treatments with the lowest irrigation volume compared to the highest. Similarly, irrigation frequency followed a similar trend with 6 days having higher ($P<0.05$) values than 3 days in all parameters measured. However, for natron (*Kanwa*)application level, there was (11% and 13%) higher ($P<0.05$) dry matter and crude protein, respectively in treatment with 40kg/ha compared to 20kg/ha during the harvesting period. Also for the mineral contents, there was an increasing trend ($P<0.05$) in all the parameters determined at 40kg/ha *Kanwa* application level except for P, Fe and K which were similar ($P>0.05$) between the treatments. It was hence, concluded thatall the treatments imposed have an effect on the chemical composition of *C. rotundifolia*. It is therefore, economically feasible for famers to irrigate the forage based on the minimum irrigation volume (25L) that supplies adequate soil moisture in combination with cheap nutrient source (40kg/ha*Kanwa*) at 6 days irrigation interval for better nutritional quality and mineral content of the forage in the Northern Guinea savannah of Nigeria. This will help to save the extra cost of labour and waste of resources, thereby increasing farm output.

Keywords: *Chamaecrista*, irrigation, mineral content, nutritional quality.

INTRODUCTION

Round-leaf cassia (*Chamaecrista rotundifolia*) also known as Wynn cassiais a short-lived self-generating annual plant belonging to the *Fabaceae* family. It is considered as one of the promising legumes for the sub humid regions of Nigeria with a crude protein of 10.7% reported under rain fed condition (Tarawali, 1991; 1994). *C. rotundifolia* is one of such forage legumes that can be used to improve the poor quality crop residues during the dry season. Natron (*Kanwa*), generally referred to as *Kanwar Lasa* in the northern part of Nigeria, primarily known as a mineral supplement fed to traditionally managed cattle is used to improve soil fertility and providing better-quality foragepartially due to nutrients other than P and Cu at lower cost thanwith commercial nitogen fertilizers (Mohamed-Saleem, 1984). In Nigeria, the major challenge for the smallholder farmer is poor quality livestock feeds (Franke *et al.,* 2011) which could be addressed through irrigated forage production in the dry season. The aim of this study was to determine the effect of varying levels of irrigation volume, irrigation frequency and natron (*Kanwa*) rates on the chemical composition of *C. rotundifolia* foragein the Northern Guinea savannah of Nigeria.

MATERIALS AND METHODS

The experiment was conducted at the irrigation site of the Institute for Agricultural Research (IAR) Samaru-Zaria located on latitudes (11^0 11′ N) and longitudes (7^0 38′ E) at an altitude of 686 m above sea level in the Northern Guinea savanna of Nigeria (Ovimaps, 2014). The relative humidity is very high during the wet season and could reach about 70-80% with highest maximum temperature of about 30^{o}C, during the dry season the relative humidity falls to about 15-20%. A composite soil sample was obtained from the experimental plots using a soil auger at the depth of 15cm for routine analysis. There was a total of 36 net plots measuring 1m^2 with 0.5m inter-row path and watering channels. The entire plot was irrigated before sowing using flood irrigation applied after every three days, until irrigation treatment was imposed at 3 weeks after sowing (WAS). Soil moisture meter was used to measure volumetric water content. The plots received 18kgNPK fertilizer/ha as uniform dressing by broadcasting and were manually weeded using a hoe before sowing. Seeds of *C. rotundifolia* and *Kanwa* rates were broadcasted in each plot at 15kg/ha. Milledsamples of *C. rotundifolia* forage collected at 4, 8 and 12 weeks post-emergence were analysed for chemical composition using the method described by A.O.A.C (2005). The mineral contents (N, Ca, Fe, K and P) were determined using atomic absoption spectrophotometer (Firtz and Schenk 1979) after wet digestion of the samples, while P was determined using calorimetric method.

DATA ANALYSIS

All data collected were subjected to analysis of variance (ANOVA) by Repeated Measures, using the Statistical Analysis System (SAS, 2003).Treatment means were separated using Dunnet's Test.

RESULTS

Results of the effect of varying levels of irrigation volume, frequency, *Kanwa*, age of maturity and their interactions on chemical composition of *C. rotundifolia* forage at 8 and 12 weeks after sowing (WAS) are presented in Table 1. Irrigation volume showed a decreasing trend (P<0.05) in order of 25L> 50L> 100L in all the chemical compositions determined. The crude protein (CP), ether extract (EE) and ash increased by 23, 27 and 16%, respectively at 8WAS in treatments with the lowest irrigation volume (25L) compared to those with the highest (100L). They showed a decreasing trend towards the harvesting period while the remaining chemical composition showed an increasing trend. Similarly, irrigation frequency followed a similar trend with 6 days having higher (P<0.05) values than 3 days in all parameters measured. However, for *Kanwa* application level, there was (11 and 13%) higher (P<0.05) dry matter (DM) and CP, respectively in treatment with 40kg/ha compared to 20kg/ha during the harvesting period. All the interactions on chemical composition were not significant (P>0.05) in the treatments throughout the sampling periods.

Table 2 shows the effect of varying levels of irrigation volume, frequency, *Kanwa*, age of maturity and their interactions on mineral composition of *Chamaecrista rotundifolia* at 8 and 12 WAS. Irrigation volume showed a decreasing trend (P<0.05) in order of 25L> 50L> 100L in all the mineral compositions determined. The N, P and K increased by 27%, 60%, and 71%, respectively at 8WAS in treatments with the lowest irrigation (25L) volume compared to those with the highest irrigation volume (100L). They showed a decreased in all the treatments during the harvesting period while Fe values remain similar (P>0.05) throughout the sampling period. Similarly, irrigation frequency followed a similar trend with 6 days having higher (P<0.05) values than 3 days in all parameters measured except for P, Fe and K which where similar (P>0.05) within the treatments. However, for *Kanwa* application level, the results showed an increasing trend (P<0.05) in all the parameters determined with 40kg/ha application level except for P, Fe and K, which where similar (P>0.05) within the treatments. All the interactions on mineral composition showed no significant differences (P>0.05) between the treatments throughout the sampling period.

DISCUSSION

The chemical compositions determined (Table 1) in this study, shows that the CP, EE and Ash increased at 8 weeks after sowing in treatments with the lowest irrigation volume compared to the highest. The CP values obtained from the study fall within 8-13% which suggests that the legume is of high nutritional quality. However, Norton (2003) observed that feed will not provide the required levels of ammonia for optimum rumen microbial activities. The CP, EE and Ash decreased with maturity while the remaining chemical composition increased. As plants mature, photosynthetic products are more rapidly converted to structural components, thus having the effect of decreasing protein and soluble carbohydrate and increasing the structural cell wall components (Ammar *et al*., 2004). It has also been reported that as the plant matured, even the leaves would become more fibrous and less digested (Van Soest, 1982). This might be the reason for lower content of CP, EE and Ash during the harvesting period of *C. rotundifolia* forage. Both NDF and ADF contents showed a linear increase with advancing maturity. This can be attributed to an increase in the cell content as the plant matures. The fibre contents obtained in the present trial fall within the range that can be digested by ruminant animals which is in line with the report of Meissner *et al.* (1991). The authors reported a safe upper limit of 60% NDF level for guaranteed forage intake by ruminant. irrigation frequency of 6 days was the most suitable irrigation frequency which allows optimum solubilization of nutrients and their easy absorption by roots. However, at 3 days irrigation interval, there could be problem of water logging which could leads to respiratory destress in plants Mani *et al.* (2006).

The mineral compositions determined (Table 2) in this study, shows that N, P and K contents increased at 8 WAS and decreased at the harvesting period in treatments with the lowest irrigation volume compared to the highest. The decreasing trend of phosphorus with increase in age is in agreement with the report of Abia (2011) who reported that phosphorus concentration in herbage decreases with increase in maturity. However, the increased in all the parameters determined with 40kg/ha of natron (*Kanwa*) application level were significant except for P, Fe and K which apperared similar within the treatments and this could be ascribed to the positive effect of *Kanwa* application on the mineral composition of the herbage. However, the range of values of phosphorus and potassium in this trial were lower than theNRC recommendation of 0.15% for Phosphorus and 0.80% for potassium respectively, for rumnant animals (NRC, 1985). The observed variations in the concentrations of minerals may be attributed to the differences in nutrient uptake from the soil (Zafar *et al.*, 2007). Mineral contents of forage species are influenced by climatic and soil factors on which plant grows (Buxton, 1996; George, 2005). The range of values for calcium in this trial can satisfactorily meet the daily calcium requirement of goats which require 0.5-1.1g of calcium per day (Alemu, 2008). However, the analyses quoted were on whole plant basis and ability of ruminants to select leaf material can often enable them to satisfy their mineral requirement.

CONCLUSION

Results of the study revealed that treatments imposed have an effect on the chemical composition of *C. rotundifolia*. It is therefore, economically feasible for famers to irrigate the forage based on the minimum irrigation volume (25L) that supplies adequate soil moisture in combination with cheap nutrient source (40kg/ha*Kanwa*) at 6 days irrigation interval for better nutritional quality and mineral content of the forage in the Northern Guinea savannah of Nigeria. This will help to save the extra cost of labour and waste of resources, thereby increasing farm output.

REFERENCES

A.O.A.C, (2005) Official Methods of Analysis of Association of Official Analytical Chemist, 17th Edition, Washington D. C., U. S. A.

Abia, E. E. (2011). Nutritive value of lablab purpureus forage cut at different stages of growth in Rabbit diets. M. Sc Thesis, Department of Animal Science, Ahmadu Bello University, Zaria, Nigeria. 93pp.

Alemu, Y. (2008). Formulation of rations for sheep and goats. Technical Bulletin No. 16. Ethiopian Sheep and Goat Productivity Improvement Program, 27pp.

Ammar, H., López S., González J. S. and Ranilla M. J. (2004) Chemical composition and in vitro digestibility of some Spanish browse plant species. In: *Journal of Science and Food Agriculture*. 84: 197–204.

Buxton, D. R. (1996). Quality related characteristics of forages as influenced by plant environment and agronomic factors. *Animal Feed Sciences and Technology*, 59: 37-49.

Firtz, J. S and Schenk, G. H. (1979). Qualitative Analytical Chemistry. 4th edition. Allyn and Bacon, Inc., Boston, Massachusetts.

Franke, A. C., Rufino, M. C. and Farrow, A. (2011). Characterization of the impact zones and mandate areas in the N2Africa Project. Milestone reference number 1.4.1, 50pp.

George, M. F., Lin, C. H., Lerch, R. N and Garrett, H. E. (2005). Incorporating forage grasses in riparian buffers for bioremediation of atrazine isoxaflutole and nitrate in Missouri. *Agroforestry System*. 63: 87-95.

Mani, H., Amans, E. B., Falaki, A. M. and Ado, S. G.(2006). Effect of NPK fertilizer and irrigation interval on growth and development of two popcorn varieties at Kadawa, Nigeria. *Journal of Crop research, Agroforestry and Environment.* 1 :26-33. Published by Department of Agronomy Ahmadu Bello University, Zaria, Nigeria.

Meissner, R., Brown, L., Durbaum, H.J., Franke, W., Fuschs, K. and Seiferet, F. (1991). Continental Lithosphere: Deep Seismic Reflections Geodyn. Ser., 22. AGU, Washington, D.C., 1991.

Mohamed-Saleem, M. A., (1984). Crop-forage interaction. Paper presented at the ILCA/NAPRI Symposium on Livestock Production in the Subhumid Zone of Nigeria, held in Kaduna, Nigeria, 30 October – 2 November 1984.

Norton, B. W. (2003). Studies of the nutrition of the Austrialians Goats. Thesis (D.Agric.) University of Melbourne. Australia. http://word cat.org l 635,38900.

NRC (1985). Nutrients requirements of beef cattle (17th edition) National Academy Press, Washington D.C. USA.

Ovimaps, (2014). Ovilocation map; ovi earth imaginary date, February, 2014

SAS, (2003) .SAS/STAT. Guide for personal computer version, 6th Edition. Statistical Analysis System Institute, Inc. Cary, North Carolina, USA.

Tarawali, S. A. (1991). Preliminary agronomic evaluation of forage legumes for subhumid West Africa. *Tropical Agriculture (Trinidad)* 68: 88-94.

Tarawali, S. A. (1994). The yield and persistence of selected forage legumes in subhumid and semi-arid West Africa. *Tropical Grasslands* 28: 80-89.

Zafar, I. K., Muhammad A., Kafeel A., Irfan M and Muhammad, D. (2007). Evaluation of micro minerals composition of different grasses in relation to livestock requirements. Pak. J. Bot. 39(3): 719-728

Table 1: Effects of varying levels of irrigation volume, frequency, levels of *Kanwa*, age of maturit y on chemical composition of Chamaecristarotundifolia at 8 and 12 weeks after sowing.

Treat ments	DM 8	DM 12	CP 8	CP 12	CF 8	CF 12	EE 8	EE 12	ASH 8	ASH 12	ADF 8	ADF 12	NDF 8	NDF 12
I.V (L)														
25	68.55^{a}	72.20^{a}	13.08^{a}	11.05^{a}	16.85^{a}	20.73^{a}	1.05^{a}	0.57^{a}	5.45^{a}	4.49^{a}	21.03^{a}	27.22^{a}	44.11^{a}	50.92^{a}
50	66.43^{b}	69.82^{b}	13.38^{a}	10.60^{b}	16.41^{a}	19.98^{b}	0.94^{b}	0.55^{b}	5.37^{a}	4.16^{b}	20.72^{a}	26.99^{a}	41.52^{b}	48.22^{b}
100	53.51^{c}	55.51^{c}	10.11^{b}	8.23^{c}	12.52^{b}	15.96^{c}	0.88^{c}	0.40^{c}	4.02^{b}	3.43^{c}	16.32^{b}	21.21^{b}	33.40^{c}	38.14^{c}
I.F (days)														
3	55.76^{b}	55.79^{b}	10.99^{b}	8.86^{b}	14.04^{b}	16.79^{b}	1.06^{a}	0.45^{b}	4.42^{b}	3.53^{b}	16.01^{b}	22.87^{b}	34.44^{b}	40.45^{b}
6	68.25^{a}	71.42^{a}	13.12^{a}	10.77^{a}	16.17^{a}	20.48^{a}	0.83^{b}	0.54^{a}	5.35^{a}	4.40^{a}	22.09^{a}	26.84^{a}	43.66^{a}	49.70^{a}
Kanwa(kg/ha)														
20	58.71^{b}	61.90^{b}	11.42	9.33^{b}	14.45^{b}	17.77^{b}	0.92^{b}	0.49	4.61^{b}	3.83^{b}	17.37^{b}	23.33^{b}	36.13^{b}	43.27^{b}
40	66.43^{a}	69.43^{a}	12.89	10.46^{a}	15.96^{a}	19.81^{a}	0.98^{a}	0.51	5.25^{a}	4.16^{a}	21.27^{a}	26.79^{a}	42.85^{a}	47.64^{a}
SEM	1.05	1.09	1.05	0.16	0.26	0.31	0.01	0.01	0.08	0.07	0.35	0.42	0.66	0.76
V×A	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
K×A	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
F×A	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
V×*K*× F× A	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

abc Means with different superscripts along the column differed significantly (P<0.05) SEM = Standard error of means I=Irrigation V = Volume *K*= Kanwa F = Frequency A = Age of plant DM = Dry matter CP = Crude protein CF = Crude fibre EE= Ether extract NDF = Neutral detergent fibre ADF = Acid detergent fibreNS= Not significant

Table 2: Effects of varying levels of irrigation volume, frequency, levels of Kanwa, age of maturity on mineral composition of Chamaecristarotundifolia at 8 and 12 weeks after sowing.

Treatments	N 8	N 12	Ca 8	Ca 12	P 8	P 12	Fe 8	Fe 12	K 8	K 12
I.V (L)										
25	1.07^{a}	0.98^{a}	0.57^{a}	0.49^{b}	0.10^{a}	0.04	0.02	0.03	0.02	0.07^{a}
50	0.97^{b}	0.86^{b}	0.56^{a}	0.52^{a}	0.05^{b}	0.05	0.01	0.02	0.04	0.02^{b}
100	0.78^{c}	0.71^{c}	0.44^{b}	0.42^{b}	0.04^{b}	0.04	0.01	0.02	0.02	0.02^{b}
I.F (days)										
3	0.77^{b}	0.69^{b}	0.46^{b}	0.43^{b}	0.08	0.03	0.01	0.02	0.02	0.04
6	1.07^{a}	0.97^{a}	0.57^{a}	0.52^{a}	0.05	0.05	0.02	0.02	0.03	0.04
Kanwa(kg/ha)										
20	0.89^{b}	0.81^{b}	0.50^{b}	0.46^{b}	0.08	0.04	0.02	0.02	0.03	0.03
40	0.98^{a}	0.87^{a}	0.54^{a}	0.50^{a}	0.05	0.04	0.02	0.02	0.02	0.04
SEM	0.02	0.01	0.01	0.01	0.02	0.01	0.01	0.01	0.02	0.01
Interaction										
V×A	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
K×A	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
F×A	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
V×*K*×F× A	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

abc Means with different superscripts along the column differed significantly (P<0.05) SEM = Standard error of means means I=Irrigation V = Volume *K*= *Kanwa* F = Frequency A = Ageof plant NS= Not significant.