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EFFECT OF CEREALS TYPE AND WATERING LEVEL ON MORPHOMETRIC CHARACTERISTICS, HERBAGE YIELD AND PROXIMATE COMPOSITIONS OF HYDROPONIC FODDER

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ABSTRACT: *This research was conducted at Prof. Lawal Abdu Saulawa Livestock Teaching and Research Farm, Federal University Dutsin-Ma, Katsina State, Nigeria. The experiment was conducted to examine the effect of cereal type, levels of watering (volume of water), morphometric characteristics, herbage yield and nutritional quality of hydroponically sprouted fodder of three different cereals (Maize, Sorghum and Millet). A completely randomised design (CRD) was deployed with three replicates per treatment. Results obtained indicated that significant differences (P<0.05) were recorded in mat-depth and fodder yield among the cereals. However, no significant differences (P>0.05) were observed in plant height and average leaf number. Furthermore, significant differences (P<0.05) were noticed in leaf length and width. Results of the proximate compositions showed that significant differences (P<0.05) were recorded in crude protein and crude fibre content. It can, therefore, be concluded that sorghum with 900ml of water recorded the best mat-depth and fodder yield, followed by maize. It is, therefore, recommended that sorghum could be used for the production of hydroponic fodder with 900ml of water per day.*

KEYWORDS: Hydroponic, Fodder and Cereal

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INTRODUCTION

The increase in population and income generation in developing countries will likely double the demand for livestock products by 2030 (Sadiq *et al.,* 2021). This strong demand has the potential to improve farmers` profitability, this will require improved animal feeding in both semi-intensive crop-livestock and fully intensive livestock systems. Nigeria has an area of about 93 million hectares, 40 million of which are available for grazing. Most of these rangelands are in the savannah zones of the country (Oyewole *et al.,* 2021), where farmers' conflict, banditry, climate change and other natural challenges become the major critical issues affecting livestock productivity in the area. The poor performance of ruminant animals in Nigeria has also been attributed to large dependence on natural pastures, which on several occasions has been reported to be low both in quantity and quality and nutrient composition when compared to their counterpart in the temperate region (Oyewole *et al.,* 2021).

It is a well-accepted fact that feeding ruminant animals is incomplete without green fodder. Green fodder is a staple feed for ruminant animals, however, due to many reasons, green fodder production has been facing a serious crisis. The major constraints in the production of green fodder by farmers are the high price of hay and grains, unavailability of land for fodder cultivation due to small land holding size of small and marginal farmers, farmers-herders conflicts and natural calamities (Sefa, 2019).

Due to the aforementioned constraints, hydroponics technology has become an alternative way of growing fodder for farm animals (Sneath and Mclntosh, 2003 and Naik, 2014). Green fodders produced without soil as a medium of growth with water supplementation and nutrients are known as hydroponics green fodder.

Hydroponic fodder can be used to address the issues of feed scarcity since hydroponically grown fodder is rich in nutrients; it helps to reduce feedstuff competition between humans and animals enables efficient utilisation of land hence, it requires small space for the establishment; and reduces the farmers' hardship in the procurement of feedstuff.

Hydroponic fodder also has good digestibility compared with conventional fodder though it may not be adequate or completely substitute high-fibre diets, it can go a long way in reducing the cost of feeding concentrates, especially for high-producing animals such as lactating and pregnant.

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MATERIALS AND METHODS

Experimental site

The experiment was conducted in Prof. Lawal Abdu Saulawa's Livestock Teaching and Research Farm, Department of Animal Science, Federal University Dutsin-Ma Katsina State. The farm is located within Latitude 12 12`18º North and Longitude 7 29`29º East with an Altitude of 605 meters above sea level with an annual average rainfall of 700mm per annual and situated in Sudan Savannah Ecological Zone, Nigeria (Gaddafi *et al.*, 2019).

Experimental Design and Layout

The experiment was laid out in a 3x3 factorial design in a completely randomised design (CRD). The factors were three cereal gains (Maize, Sorghum and Millet) and three levels of watering (300, 600 and 900ml of water) replicated three times. All treatment trays were randomly placed in the hydroponic chamber.

Seed collection, preparation and germination

The grains (Maize, Sorghum and Millet) were procured from a local market in Dutsin-Ma. The seeds were sorted and treated with dilute hydrochloric acid. The seeds were sundried to 12-14% moisture level. The seeds were then soaked in fresh water for 24 hours. Then, the seeds were incubated in a gunny bag for 24 hours before being transferred into germination trays inside the chamber. After germination, the fodder was irrigated three times daily according to treatment.

Data Collection

Germination percentage: Germination percentage was recorded as the number of germinated seeds ÷ Total number of seeds in tray X 100

Plant height (cm): The plant height was calculated in centimetres from root to shoot by using the metre rule. In each tray, five plants were selected randomly, and their mean height was determined.

Number of leaves: The number of tillers per plant was taken and recorded.

Green fodder weight (g): Green fodder weight was calculated at 10 days after sowing.

Forage yield (%) = Weight at harvest (kg) Weight at planting (kg) / Weight at harvest (kg) X 100

Biomass Yield of Fodder determination

Immediately after harvesting the fodder, the fresh yield was recorded by weighing on a balance, and the yield was expressed in Kg.

Proximate Analysis

The representative samples from each replicate of the treatments were taken to the laboratory for proximate analysis using the procedure outlined by AOAC (2020).

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Data Analysis

Data obtained from this study were managed in Excel Office 2010; thus, data generated were analysed using SAS Version 2002. Means were separated using the Duncan Multiple Range Test as outlined by Steele Toyle 1980.

RESULT

Fodder yield and mat depth on the selected cereals used in hydroponic fodder production

The result of fodder yield and mat depth using different cereals are presented in Table 1 below. From this study, it is very clear that maize, sorghum, and millet are potential cereals that can be used for hydroponic fodder and can produce a good quality yield in a short time. Naik et al. (2014) stated that the growth of fodder within a few days is an indication of the good attributes of maize and sorghum as a potential hydroponic fodder species that takes place only 8 days to develop from seed to fodder where it took at least 75 days for a conventional fodder to grow.

The result revealed that there were significant ($P<0.05$) differences in mat depth, fodder yield in weight and percentage. Sorghum had the highest mat depth (3.76cm), followed by maize with 3.26cm, while millet had the lowest mat depth (1.36 cm) in this study. The variations in mat depth in this study might result from seed size even though the same quantity was used. Similarly, Sorghum tends to have the highest fodder yield weight and fodder yield percentage (3.68kg and 98.41%, respectively), while millet had a 2.97kg fodder yield weight with 30.41% percentage fodder yield. The lowest fodder yield weights were obtained in maize with 1.92 kg and possessed 31.58% fodder yield percentage. Information on the fodder yield is, therefore, essential and is accelerated by as much as 25% by bringing the nutrients directly to the plants without developing large root systems to seek out food. The fodder yield obtained for sorghum and maize in this study is in agreement with the report of Sneath and McIntosh (2003), who reported that 1 kg of un-sprouted seed yields 8-10kg of green forage in just 7-8 days.

Table 1: Fodder yield and mat depth of the selected cereals used in hydroponic

Parameters	Maize	Sorghum	Millet	SEM	LOS
Mat depth (cm)	3.26^{b}	3.76^{a}	1.36^{c}	0.06	*
Fodder yield (kg)	1.92^{c}	3.68^{a}	2.97^{b}	0.01	*
Fodder yield (%)	31.58^{b}	98.41^{a}	30.41^{b}	0.01	*

Effect of varying watering levels on fodder yield and mat depth of hydroponic fodder

The effect of watering levels on fodder yield and mat depth are presented in Table 2 below. The result suggests that there were no significant ($P>0.05$) differences in mat depth for maize, sorghum, and millet irrigated using different water volumes. However, the result clearly indicated that there were significant ($p<0.05$) differences in fodder yield weight and percentages of maize, sorghum, and miller irrigated using different dosage levels of water. The highest ($P<0.05$) numerical values were observed in hydroponic maize irrigated with 900mls of water (2.95kg) fodder yield weight, followed by 2.80kg and 2.51kg for 600mls and 300mls of water, respectively. The result further shows a higher fodder yield percentage in maize

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irrigated with 900mls of water (95.70%) followed by 600mls (86.96%), and the lowest percentage was obtained in maize irrigated with 300mls of water with 77.49%.

Table 2: Fodder yield and Mat depth as affected by watering volume

Parameters	300ml	600ml	900ml	SEM	LOS
Maize					
Mat depth (cm)	3.34[a]	3.50[a]	3.55[a]	0.036	NS
Fodder yield (Kg)	2.51[b]	2.80[a]	2.95[a]	0.022	*
Fodder yield (%)	77.49[b]	86.96[ab]	95.70[a]	0.013	*
Sorghum					
Mat depth(cm)	2.98[a]	3.00[a]	3.15[a]	0.027	NS
Fodder yield(kg)	3.16[b]	3.4[a]	4.15[a]	0.141	*
Fodder yield (%)	79.50[b]	84.31[a]	86.70[a]	0.092	*
Millet					
Mat depth(cm)	3.01[a]	3.11[a]	3.16[a]	0.046	NS
Fodder yield(kg)	2.96[a]	3.41[a]	3.40[a]	0.061	NS
Fodder yield (%)	81.70[a]	82.20[a]	81.96[a]	0.015	NS

Morphometric characteristic of hydroponic fodder production.

The effect of morphometric parameters in hydroponic fodder production is presented in Table 3 below. The result shows that there were no significant ($P>0.05$) differences in plant height and leaf number of Maize, Sorghum and Millet. Sorghum has the highest plant height, 48.21cm, followed by Maize and Millet, with 46.45cm and 45.21cm, respectively. So also the average leaf number of Sorghum, Maize and Millet were 5.00, 4.00 and 4.00 respectively. However, the result revealed that there were significant ($p<0.05$) differences in leaf length and leaf width of maize, sorghum and millet. Sorghum has a higher average leaf length than Millet and Maize (37.40, 36.21 and 30.00, respectively), while Maize has a higher average leaf width of 5.8cm, followed by Sorghum and Millet (3.7cm and 2.11cm respectively). The significant increases in leaf length and width observed in this study could be a clear indicator that cereal is good in hydroponic fodder production and good in producing palatable and succulent biomass for livestock. This could be in agreement with Starova-Jeton's (2016) suggestion, who said hydroponic fodders are highly digestible, palatable and relished by animals. They are highly succulent and can intake 1-1.5% of the body weight (Starova-Jeton, 2016).

Table 3: Effect of hydroponic Fodder on morphometric parameters

Parameters	Maize	Sorghum	Millet	SEM	LOS
Average plant Height (cm)	46.45[a]	48.21[a]	45.21[a]	0.132	NS
Average leaf number	4.00[a]	5.00[a]	4.00[a]	0.034	NS
Average leaf length (cm)	30.00[b]	37.40[a]	36.21[a]	0.732	*
Average leaf width (cm)	5.8[a]	3.7[b]	2.11[b]	0.031	*

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Effect of Hydroponic Fodder on proximate composition of cereals

The result of the chemical composition of hydroponic fodder grown using 3 different cereals is presented in Table 4 below. The result showed that there were no significant ($p>0.05$) differences in Dry Matter, Ether Extra and Ash content of Maize, Sorghum and Millet. However, the results further showed there were significant ($P<0.05$) differences in Crude protein and Crude fibre content of Maize, Sorghum and Millet. Maize recorded the highest percentage of dry matter content, 24.17%, followed by Sorghum 23.28% and Millet 23.11%. The Crude protein content indicated that maize had a higher percentage, followed by Sorghum and Millet (19.20%, 16.21% and 13.16%, respectively). In Crude fibre content, Maize also had a high percentage, followed by Sorghum and Millet (26.96%, 21.14% and 16.96%, respectively). In Ether, extra Maize also has a high percentage, followed by Sorghum and Millet (4.10%, 3.41% and 3.40%, respectively). Finally, ash-content maize also had a high percentage, followed by Sorghum and Millet (4.28%, 3.71% and 3.12% respectively). The significant variations observed in CP and CF content in this study may be attributed to multiple factors such as cereal type, stage of growth, and irrigation volume, among others. Fazaeli *et al.* (2011) suggested that hydroponic fodder from cereal grains deviates in their nutrient content. Once the starch content decreases, both organic matter and dry matter content decrease. The proximate composition of maize analysed in this study falls with the proximate composition of hydroponic fodder produced by maize by Tanuva (2015) of 76.75% moisture, 10.85%cp, 5.5% CF, 4.62%EE and 77.52%NFE.

Table 4 Proximate composition of hydroponically grown fodder

Parameters (%)	Maize	Sorghum	Millet	SEM	LOS
DM	24.17^{a}	23.28^{a}	23.11^{a}	0.19	NS
CP	19.20^{a}	16.21^{a}	13.16^{b}	0.24	*
CF	26.96^{a}	21.14^{a}	16.96^{b}	0.6	*
Ether Extract	4.10^{a}	3.41^{a}	3.40^{a}	0.12	NS
Ash	4.28^{a}	3.71^{a}	3.12^{a}	0.24	NS

CONCLUSION

i. It can be concluded that sorghum gives the best mat-depth fodder yield in weight and percentages in this study, followed by maize.

ii. For adequate yield production, it is also concluded that 900ml of watering gives better fodder yield.

iii. The proximate composition of hydroponic fodder in this study indicated maize had the highest Crude protein and crude fibre content.

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RECOMMENDATION

Therefore, sorghum could be the best hydroponic fodder when irrigated with 900ml of water three times per day, and maize could give a better proximate composition for improving livestock productivity.

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