EFFECT OF WATERING VOLUME AND PLANTING DENSITY ON FODDER YIELD OF SELECTED TROPICAL CEREALS IN HYDROPONIC PRODUCTION

***Odedire, J.A., Akinropo, T.F. & Akinleye, J.A**
Department of Animal Sciences, Obafemi Awolowo University, Ile-Ife, Osun State. 220005
**Corresponding author: akinropotobifestus@gmail.com*

ABSTRACT
The study was conducted to evaluate the effect of watering volume and planting density on the fodder yield of selected tropical cereals in hydroponic fodder production. Guinea corn (*Sorghum bicolor*), Millet (*Pennisetum glaucum*) and Wheat (*Triticum aestivum*) were used for the study. The experiment was laid out in a 3x3x3 factorial design with grain type, planting densities and watering volume as the three factors. The cereals were employed in hydroponic fodder production and data obtained were subjected to factorial analysis of variance and significantly ($P<0.05$) different means were separated using Duncan multiple range test of SAS (2003). Results indicated Guinea corn had the highest ($P<0.05$) mat depth and fodder yield with 3.65cm and 145.02% respectively, while wheat recorded the least values.Planting density also improved ($P<0.05$) mat depth and fodder yield, while Watering volume only impacted ($P<0.05$) on the cereals mat depth and fodder yield up till 500ml.The study concluded that cereal type, planting density and watering volume influenced mat depth and fodder yield in hydroponic forages.

Keywords: Hydroponic forages, guinea corn, millet, wheat,Mat depth, Fodder yield

INTRODUCTION
Human population increase is putting pressures on the available land for grazing and farming activities. This has resulted in recurrent clashes between cattle herders and settled crop farmers when competing for the available limited resources. There is therefore the need for a sustainable approach to ameliorate this recurrent clashes (Odedire, 2018). One of such approach is the use of hydroponic technology to grow forages for cattle and other grazing livestock, especially during the period of feed scarcity that is more crisis - prone. The potential of hydroponic fodder as a feed resource for livestock feeding is big, due to its high yielding ability and improved nutritive values of grains employed in the production system (Odedire *et al*, 2019). This study aimed to evaluate the effect of watering volume and planting densities on some selected cereal grains in the tropics.

MATERIALS AND METHODS
The experiment was conducted at the Animal Ecology Laboratory of the Department of Animal Sciences, Obafemi Awolowo University, Ile-Ife. A locally adapted hydroponic chamber (Odedire, 2018) was employed for this experiment which lasted 21 days.The experiment was laid out in a 3x3x3 factorial design, where the factors were the selected cereal grains (Wheat, Millet and Guinea corn); Planting density (0.56, 0.83 and 1.11 kg/m^2); and watering volume (250, 500 and 750ml) giving a total of 27 treatments which were replicated thrice.The grains were procured from a local market in Ile-Ife. The grains were sorted, washed, disinfected with hypochlorite and the disinfected grains were spread out in a 60cm×30cm×6cm perforated galvanized sheet tray and covered with aluminium foil for 24 hours. The trays were then placed in the hydroponic chamber and watering was done thrice daily for the 7 days after which the hydroponic forages were harvested. Daily weight changes were recorded and Fodder yield was calculated according to the method of Fazaeli *et al.*, (2011) where:

$$\text{ForageYield}(\%) = \frac{\text{Weight at harvest (kg)} - \text{Weight at planting (kg)}}{\text{Weight at Harvest (kg)}} \times 100$$

Mat depth (clustered and intertwined roots) of the hydroponic fodder was measured with the aid of a graduated ruler. All data collected were subjected to analysis of variance and significantly ($P<0.05$) different means were separated using Duncan multiple range test of SAS (2003).

RESULTS AND DISCUSSION

Table 1 shows the mat depth and fodder yield of the selected grains' hydroponic fodders.There were significant differences (P<0.05) among the means of the mat depth and fodder yield.Mat depth ranged from 1.23cm (millet) to 3.65cm (guinea corn). Highest fodder yield was obtained for guinea corn (145.02%) and the least (26.54%) obtained for wheat.The result showed that guinea corn performed better than millet and wheat in this study. Millet and wheat have been reported to be highly susceptible to mould infestation (Myers, 1974). The cereals employed in this study were sourced from the open market which might have affected seed purity and germination capacity. The fodder yield recorded in this study were lower than reported values (Sneath and McIntosh, 2003; Naik *et al.*, 2013)but higher than the values reported by Odedire *et al.*, (2019). Variation in the hydroponic forage yield may be attributed to the purity of seed and degree of mould infestation.The fodder yield for wheat was the lowest as wheat has been reported to be highly susceptible to *Fusarium spp*. (Saharan and Neaf, 2008).

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

Cereal type	Mat depth (cm)	Fodder yield (kg)	Fodder yield (%)
Guinea corn	3.65^{a}	3.51^{a}	145.02^{a}
Millet	1.23^{c}	2.85^{b}	88.62^{b}
Wheat	3.19^{b}	1.87^{c}	26.54^{c}
P value	0.017	0.01	0.01

^{abc,} Means within Column with different superscript are significantly different (p<0.05)

Table 2: Effect of planting density on mat depth and fodder yield

Planting Density (kg/m^2)	Mat depth (cm)	Fodder yield (kg)	Fodder yield (%)
0.56	2.39^{c}	2.03^{c}	69.77^{c}
0.83	3.23^{b}	2.81^{b}	87.05^{b}
1.11	4.64^{a}	3.39^{a}	103.35^{a}
P value	0.001	0.0001	0.0001

^{abc,} Means within Column with different superscript are significantly different (P<0.05)

Table 3: Fodder yield and mat depth as affected by watering volume

Watering volume(ml)	Mat depth (cm)	Fodder yield (kg)	Fodder yield (%)
750	3.50^{a}	2.93^{a}	95.68^{a}
500	3.43^{ab}	2.78^{a}	86.95^{ab}
250	3.33^{a}	2.53^{b}	77.55^{b}
P value	0.0342	0.0219	0.0126

^{abc,} Means within Column with different superscript are significantly different (P<0.05)

Table 4: Effect of factors and their interaction on the fodder yield parameters

Parameters	Cereal type (P Value)	Planting Densities (P Value)	Watering Volume (P Value)	CT*PD (P value)	CT*WV (P value)	WV*PD (P value)	CT*PD*WV (P value)
Mat Depth(cm)	0.017	<.0001	0.37	<.0001	0.1423	0.012	0.0349
Folder yield (kg)	0.01	<.0001	0.002	<.0001	<.0001	0.001	0.0001
Percentage Increase in sprouted folder yield (%)	0.01	<.0001	0.013	<.0001	<.0001	<.0001	<.0001

*CT*PD: Cereal type * Planting Densities; CT*WV: Cereal type* Watering Volume; WV*PD: Watering Volume* Planting Densities; CT*PD*WV: Cereal type * Planting Densities*Watering Volume*

Table 2 shows the effect of the Planting density on the Mat depth and Yield of the hydroponic fodder. There were significant differences ($P<0.05$) among the means of mat depth and fodder yield, as the values of both the mat depth and fodder yield nearly doubled when planting density was increased from 0.56 to 1.11kg/m^2. Increasing the watering volume from 250ml to 500ml improved ($P<0.05$) the mat depth and the fodder yield of the cereals but the results of 500 and 750 ml were similar ($P>0.05$). The implication is that watering volume beyond 500ml will create a water logging effect if the tray has no facility for drainage which would eventually result in seed degeneration. The result obtained for the optimum watering volume contrasts Al-Karaki, (2010)who reported that about 1.5-2 litre is required to produce 1 kg of green fodder hydroponically, but agrees with the submission of the author that hydroponically grown fodder requires less amount of water to produce 1 kg green fodder in comparison to 73, 85 and 160 litres to produce 1 kg of green fodder of barley, alfalfa, and Rhodes grass under field conditions respectively.Table 4 shows the interaction effect of the factors on the mat depth and fodder yield. All the factors (watering volume, planting density and cereal types) significantly affect hydroponic fodder yield and mat depth production.

CONCLUSION

It was concluded from this study that Mat depth and Fodder yield are influenced by Watering volume, Planting densities and Cereal type. Guinea corn (*Sorghum bicolor*) gave the best performance among the cereals studied and Planting density of 1.11kg/m^2 with Watering volume of 500ml is recommended for optimum performance.

REFERENCES

Al-Karaki G. N. and Al-Momani, N. (2010). Evaluation of some barley cultivars for green fodder production and water use efficiency under hydroponic conditions," *Jordan Journal of Agricultural Sciences*. 7(3): 448-456

Fazaeli, H. A. Golmohammadi, A. A. Shoayee, N. Montajebi, and S. Mosharraf, S.H.(2011). Performance of feedlot calves fed hydroponics fodder barley. *Agricultural Science and Technology Journal* 13:367-375.

Lorenz, K. (1980). Cereal sprouts: composition, nutritive value, food applications.*Crit. Rev. Food Sci.* Nutr.13 (4): 353-385.

Myers,J.R.(1974).Feeding Livestock from the Hydroponic Garden.AgricultureDepartment.Phoenix, Arizona State University.

Naik P K, Dhuri R B, Swain B K and Singh N P. (2013). Nutrient changes with the growth of hydroponics fodder maize. *Indian Journal of Animal Nutrition* 29:161-163

Odedire J.A. (2018). Preliminary Investigation of Some Common Cereals as Sources of Hydroponic Fodder in the Tropics. *Proceedings of the 43rd Annual Conference of the Nigerian Society for Animal Production* held at the Federal University of Technology, Owerri, 18th – 22nd March, 2018. Pp.812 – 814.

Odedire J.A., Akinropo, T.F. and Oyarinde, O.D. (2019). Yield and Nutritive Value of Hydroponic Fodders as influenced by Frequency of Watering. *Proceedings of the 44th Annual Conference of the Nigerian Society for Animal Production* held at University of Abuja, Abuja, 21st–24th March, 2019. Pp.207 – 211.

Saharan, M.S. and Naef, A. (2008). Detection of genetic variation among Indian wheat head crab pathogens (*Fusarium spp,*/isolates) with microsatellite markers.*Crop protection*27: 1148 -1154. http:doi.org/10.1016/j.cropro.2008.01.008

SAS (2003). Statistical Analytical System institute SAS/STAT User's guide. SAS Institute, Cary North Carolina, USA.

Sneath R and Mclntosh F. 2003. Review of Hydroponic Fodder Production for Beef Cattle. Queensland Government, Department of Primary Industries, Dalby, Queensland. 54pp.