
THE EFFECT OF GROWTH PERIOD ON THE MACRO AND MICRO MINERAL CONCENTRATION IN SORGHUM AND MILLET HYDROPONICS FODDERS

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ABSTRACT

*This study determined the growth effect of the sprouting period on macro and micro mineral concentration of hydroponics fodder produced from white sorghum, red sorghum (*sorghum bicolor*) and millet (*pennisetum glaucum*) seed. 2.5 kilograms each of the selected seeds were divided into five groups of 500 g each, and tagged T₁, T₂, T₃, T₄ and T₅, with T₁ being the unsprouted seeds and serving as the control, while the T₂ – T₅ were sprouted. The seeds were transferred to plastic buckets with perforated lids, and soaked in water for 4 hours to activate them. Thereafter, the water was drained, and the seeds left in plastic buckets for 24 hours to further hasten their sprouting. The seeds were then transferred to properly labeled plastic trays measuring approximately 487.68cm and depth of 2.54cm, and having one end perforated to allow for water drainage. The set-up was therefore 15 trays made up of 5 trays per seed type in a randomized complete block design (RCBD). The seeds were irrigated trice daily with bore-hole water for 8 days to produce the hydroponic fodders. The mineral concentrations of the fodders were determined at the day 0, 4, 6, and 8 of growth. Progressive increase in the macro and micro-mineral concentration, with sprouting days, was also observed with the 8th day values being significantly higher ($p < 0.05$) than the others. Fe content was much higher in the 6th and 8th day millet fodder than the sorghum fodder, while the zinc and manganese content of the 8th day white sorghum fodder were also much higher than the others. Both the sorghum and millet seeds can be used for hydroponic fodder production in south eastern Nigeria.*

Keyword: Hydroponics, sprouted seeds, fodder, sorghum, millet

INTRODUCTION

Hydroponic fodder production is a method of fodder production, in which fodder seeds are germinated into a high quality, highly nutritious, disease free animal food in a hygienic environment (Jensen and malter1995; Al-Hashmi, 2008). Hydroponic fodder has the advantage of being essentially organic because herbicides, pesticides, and other chemicals are not applied during its production (Girma and Gebremariam, 2018; Bari *et al.*, 2022). The technology has therefore been used for year – round fodder production with least water consumption. It is free of soil, chemical fertilizer, herbicides and pesticides and can, produce 10 times the amount of conventional fodder as the traditional fodder production system (Rodriguez *et al.*, 2004). Hydroponic method have been used for a long time to grow plants, especially vegetables, and is now being used across many countries to take pressure off the land, and overcome shortage of water, erratic rainfall, and frequent draught that constrain the growing of green feed for livestock and poultry.(Al-Karaki and AlHashimi, 2012).Hydroponic fodder production technology could be adopted by the ruminant farmers in places like northern Nigeria where shrinking pastoral lands has led to conflicts between crop farmers and pastoralists (Kubkomawa, 2016).It is therefore necessary to evaluate local seed varieties intended for use in hydroponic fodder production. This study determined the effect of the sprouting period on macro and micro mineral concentration in hydroponic fodder produced from sorghum and millet grains.

MATERIALS AND METHODS

Three common grains, white and red sorghum (*Sorghum bicolor*) and pearl millet (*Pennisetum glaucum*) were purchased from wholesalers in a local market at Owerri, south eastern Nigeria, and used for the experiment, within two weeks of their collection. The seeds were sorted to remove foreign substances such as stones, chaff, metals, and insects. Four replicates of 500 g of each seed type were weighed with a digital scale, into plastic buckets and soaked liberally with clean borehole

water for four hours to prime or activate them. The water was drained and the seeds were transferred to plastic trays of known weight measuring approximately 487.68cm and a depth of 2.54cm, and perforated at one end to allow for draining of excess water. The trays were arranged on a wooden rack in an airy, naturally lit room, and watered three times daily for 8 days to produce the hydroponic fodders. Another 500 g of each seed type was spread on similar plastic trays and kept on the rack to serve as the control. The experimental design is therefore a randomized complete block design. The seeds were irrigated three times daily with clean borehole.

RESULT AND DISCUSSION

Tables 1 highlight the macro mineral concentration in white sorghum, red sorghum and millet seeds derived hydroponic fodders. Across fodder types, there was progressive increase in the macro mineral concentrations with increasing sprouting days, such that the 8th day values were significantly higher ($p<0.05$) than the values recorded on the previous days for all the minerals. The fodders produced from the two sorghum varieties recorded much lower mineral values, than the millet fodder. These results may be attributed to the genotypic differences of the seeds since they were watered similarly during the fodder production. Similar meaningful increases in calcium, phosphorus and magnesium contents of wheat grain fodder with advancement in growing days has also been reported by Bari *et al.* (2022).

Table 1: Macro mineral composition of white sorghum

Parameters(mg/100g)	T1 0 day	T2 1 day	T3 4 days	T4 6 days	T5 8 days	SEM
Calcium	17.10 ^d	12.61 ^c	18.28 ^b	18.44 ^b	21.16 ^a	0.93
Phosphorus	35.20 ^e	66.79 ^d	120.95 ^c	154.89 ^b	163.38 ^a	16.62
Magnesium	10.20 ^e	28.16 ^d	36.09 ^c	37.20 ^b	42.61 ^a	3.77
Potassium	26.79 ^d	24.10 ^e	30.81 ^a	30.10 ^b	28.45 ^a	0.80
Sodium	7.80 ^e	21.21 ^d	21.95 ^c	54.66 ^b	55.27 ^a	6.43

Means with different superscript on the same row are significantly different ($p<0.05$)

Table 2: Macro mineral composition of red sorghum

Parameters(mg/100g)	T1 0 day	T2 1 day	T3 4 days	T4 6 days	T5 8 days	SEM
Calcium	21.30 ^e	25.40 ^d	28.16 ^c	36.15 ^b	39.46 ^a	2.25
Phosphorus	29.88 ^d	38.29 ^c	38.57 ^c	75.90 ^b	81.04 ^a	7.10
Magnesium	7.03 ^e	8.03 ^d	17.28 ^c	22.01 ^b	28.39 ^a	2.72
Potassium	19.46 ^b	10.60 ^d	10.10 ^e	15.50 ^c	21.97 ^a	157
Sodium	4.05 ^e	4.95 ^d	16.10 ^c	16.80 ^b	18.29 ^a	2.07

Means with different superscript on the same row are significantly different ($p<0.05$)

Table 3: Macro mineral composition of millet

Parameters(mg/100g)	T1 0 day	T2 1 day	T3 4 days	T4 6 days	T5 8 days	SEM
Calcium	24.50 ^e	33.16 ^d	34.06 ^c	45.60 ^b	49.30 ^a	9.48
Phosphorus	103.85 ^e	123.94 ^d	145.76 ^c	179.14 ^b	188.61 ^a	33.84
Magnesium	91.08 ^e	111.55 ^d	120.20 ^c	133.90 ^b	137.42 ^a	17.62
Potassium	164.19 ^e	206.59 ^d	211.31 ^c	217.58 ^b	225.46 ^a	22.46
Sodium	3.98 ^e	5.08 ^d	16.00 ^c	16.78 ^b	21.03 ^a	7.16

Means with different superscript on the same row are significantly different ($p<0.05$)

The results in tables.4 to 6 highlight the micro-mineral concentrations of hydroponic fodders produced from white sorghum, red sorghum and millet seeds. There was a progressive increase in the micro-mineral contents with increasing age of the fodders, such that the 8th day fodders recorded significantly higher ($p<0.05$) mineral values than the others. The iron content in the 6th and 8th day millet fodders were higher than those of the sorghum varieties, while the 8th day zinc and Mn

contents of white sorghum fodder were also much high than those of the red sorghum and the millet fodders. The concentration of Fe in the 6th and 8th day millet fodder were much high than those of the sorghum varieties, while the 8th day zinc and Mn content of the white sorghum fodder were also much high than those of the red sorghum and the millet fodder.

Table 4: Micro mineral composition of white sorghum

Parameters(mg/100g)	T1 0 day	T2 1 day	T3 4 days	T4 6 days	T5 8 days	SEM
Iron	4.23 ^d	9.94 ^c	10.30 ^b	10.32 ^b	11.10 ^a	0.83
Manganese	1.72 ^e	5.29 ^d	8.66 ^c	11.39 ^b	12.98 ^a	1.36
Zinc	2.08 ^e	3.51 ^d	3.87 ^c	4.11 ^b	4.22 ^a	0.26
Copper	0.72	0.62	1.09	1.08	1.06	0.10

Means with different superscript on the same row are significantly different (p<0.05)

Table 5: Micro mineral composition of red sorghum

Parameters(mg/100g)	T1 0 day	T2 1 day	T3 4 days	T4 6 days	T5 8 days	SEM
Iron	7.61 ^c	6.39 ^e	7.02 ^d	8.31 ^b	8.98 ^a	0.30
Manganese	0.51 ^d	0.70 ^d	3.22 ^c	4.02 ^b	4.86 ^a	0.59
Zinc	1.40 ^b	1.18 ^c	1.23 ^c	1.46 ^b	2.84 ^a	0.21
Copper	0.30 ^c	0.30 ^c	0.88 ^{ab}	0.84 ^b	0.92 ^a	0.10

Means with different superscript on the same row are significantly different (p<0.05)

Table 6: Micro mineral composition of millet

Parameters(mg/100g)	T1 0 day	T2 1 day	T3 4 days	T4 6 days	T5 8 days	SEM
Iron	2.22 ^e	7.04 ^d	10.11 ^b	23.10 ^b	23.78 ^a	9.17
Manganese	1.03 ^e	5.19 ^c	6.00 ^b	7.03 ^a	7.08 ^a	2.35
Zinc	0.69 ^c	1.04 ^b	1.06 ^b	1.09 ^b	1.21 ^a	0.18
Copper	0.99 ^b	1.01 ^b	1.04 ^{ab}	1.04 ^{ab}	1.09 ^a	0.10

Means with different superscript on the same row are significantly different (p<0.05)

CONCLUSION

There was progressive increase in the macro and micro-mineral concentration of millet and sorghum. The white sorghum, red sorghum and millet are appropriate for hydroponic fodder production for livestock feeding in Nigeria. The mineral compositions of the hydroponic fodders suggest that they will serve mostly as ruminant feedstuff.

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