PRM -08

Preliminary Investigation of Some Common Cereals as Sources of Hydroponic Fodder in the Tropics

J.A. Odedire
Department of Animal Sciences, Obafemi Awolowo University, Ile – Ife, Osun State, 220282
Corresponding author: J.A. Odedire; E-mail: oadeolu1@gmail.com ; +2348038549533

Abstract
In an effort to mitigate the problem of seasonal forage availability, as well as land space as a result of increasing urbanization and protracted conflicts between nomadic cattle herders and settled crop farmers, seeds of some common cereals in Nigeria were evaluated for their potentials as sources of hydroponic fodder production. Millet (*Pennisetum glaucum* L.), sorghum (*Sorghum bicolor* L.) and rice (*Oryza sativa* L.) were sourced from the open market and placed in a locally fabricated hydroponic chamber with detachable galvanized trays of 2.0 ft × 1.0 ft × 3" dimension. Seeds were watered once daily using a manual spraying pump. Parameters measured include daily weight changes and sprouted height. All the cereals produced good matt by day 8. Sorghum and rice showed resistance to mould while millet was susceptible to mould under prevailing tropical growing conditions. Sprouted fodders increased by 233%, 308% and 267% for millet, sorghum and rice respectively. Mean sprouted height varied ($p< 0.05$) from 8.5 cm in millet, to 11.9 cm in rice and 12.3 cm in sorghum. It can therefore, be concluded that sorghum and rice hold the potential as hydroponic fodder in the tropics and the technology could be employed in conflict aversion in Nigeria's livestock industry.

Keywords: Hydroponics, maize, millet, rice, sorghum, sprouted fodder

Introduction

The need for continuous access to quality feed all year round is critical for the sustainability of any livestock production enterprise. All year round supply of feed is still a major challenge for livestock production in the humid tropical country, such as Nigeria where a major problem of grazing livestock is the heavy dependence on natural grasslands whose availability and nutritional value is seasonal and shrinking. This has created a perennial phenomenon of "North – South movement" for the traditional nomadic cattle herders who own the largest percentage of the country's grazing livestock. In Nigeria over the years, there had been reports of conflict between Nomadic cattle herders and settled crop farmers of the Middle belt and Southern extraction, where reasonable quantity of grazing forage still exists at the onset of the dry season, but recent incidents and evidence have taken a frightening dimension where such conflicts had resulted in the loss of hundreds of lives. As such, a technology that will encourage the production of high quality forages within limited space and at minimal cost could be a solution to this problem.

Mooney (2005) opined that hydroponics technology is a great asset for highly populated regions where growing space is a problem and where agriculture is difficult. The technology also allows farmers to have absolute control of the fodder production throughout the year, independent of the effects of weather, such as hails or shine that could destroy the fodder. Hydroponics is a form of soilless culture system where plants are provided with nutrients and support through artificial means (Ghehsareh *et al*., 2011). The benefits of soil-free fodder production in a containerised system from cereal such as barley are enormous and proven successful in many semi-arid and desert countries (Akbag *et al*., 2014). These include disease-free plants, superior nutritive value and high animal productivity including greater milk yield, improved fertility and faster growth (Jelan and Dahan, 1998).

It was reported that green fodder produced under hydroponic conditions has high metabolizable energy, crude protein and digestibility (El-Morsy *et al*., 2013). Hydroponic fodder production allows water use economy and early maturation (Akbag *et al*., 2014). The green fodders are harvested in approximately 7 days in hydroponic system (Naik and Singh, 2013). The concept of putting 1kg of seeds into the hydroponics system and producing 6-10 kg fresh green sprouts independent of weather at any time of the year is of interest (Kruglyakov, 1989 as cited in Fazaeli *et al*., 2012). The most commonly reported cereal grain for hydroponics is barley which is scarce in Nigeria due to the prevailing weather conditions whereas cereals such as rice, sorghum, millet and maize are widely cultivated in the country (Ismaila *et al*., 2010).

Therefore, a preliminary evaluation was conducted to assess the potential of three of these common cereals (millet, sorghum and rice) in hydroponic fodder production for livestock feeding.

Materials and Methods

Seeds of millet (*Pennisetum glaucum* L.), sorghum (*Sorghum bicolor* L.) and rice (*Oryza sativa* L.) were purchased from the open market. In order to remove dirts, the seeds were washed with detergent and thoroughly rinsed in clean water and thereafter soaked 5% sodium hypochlorite for one hour (for sterilization). Thereafter the seeds were drained of the water and placed in a locally fabricated hydroponic chamber with detachable galvanized trays of 2.0 ft × 1.0 ft × 3" dimension. The trays were then covered for 24 hours to initiate the sprouting process through biochemical activities of the seed. After the 24-hour sprouting initiation, the trays were uncovered and subsequently watered once daily, using a hand sprayer under room temperature (24 - 31°C) and 75 – 88% relative humidity. The sprouting fodder were observed for daily weight changes and at the end of 8 days, the sprouted height and weight of the fodder were recorded and the hydroponic fodders observed for incidence of mould.

Results and Discussion

The cereals produced hydroponic green fodders that looked like a mat consisting of roots, seeds and plants (Naik *et al.,* 2011 as cited in Naik *et al*., 2012; Fazaeli *et al*., 2012). Figure 1 shows the mean weight changes of the sprouted fodders. Across the three cereals, the fodders recorded a linear increase in weight as the sprouting days progressed but the weight changes were observed to be sharply increased after day 3, which suggests a possible increase in metabolic activities of the seedlings and mobilization of major reserves within the embryo (Chavan and Kadam, 1989; Bewlely, 1997). The proportional weight increase of the sprouted fodders was lower than the expected 600 – 1000 percent increase (Kruglyakov, 1989 as cited in Fazaeli *et al.*, 2012). The low yield of the cereal hydroponic fodder in the current study may not be unconnected to the frequency of moisture contact with the sprouting fodders since watering was done once daily.

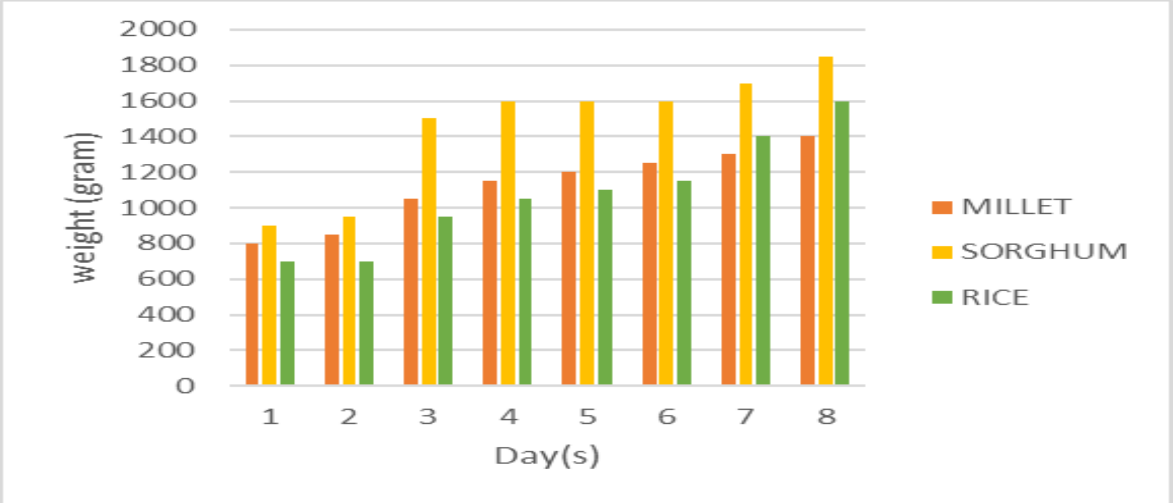


Fig. I: Mean weight changes of the sprouted cereals over the 8 – day period

Figure II shows the mean height of the three sprouted forages. It was observed that a positive correlation seems to exist between the weight changes and the sprouted height of the hydroponic fodders in the present study as the cereal with the highest weight change equally recorded the highest mean height at 8 days. Except for paddy rice, it was observed during the experimental period that millet and sorghum were susceptible to mould infection, which could be traced to poor post – harvest handling practice as the core suppliers of these seeds are mainly the peasant crop farmers with little or no training in seed harvest and preservation technology. Mould has been reported as the most challenging factor in hydroponic fodder production (Macharia, 2015) with a huge potential of great losses to farmers.

Conclusion and Recommendations

Hydroponic fodder production is feasible with other cereal grains such as millet, sorghum and rice in a country as Nigeria. Rice (*Oryza sativa*) can be easily adapted for hydroponic fodder production by local farmers where facilities for growing chamber are unaffordable or inadequate. The technology has the potential of transforming the nation's livestock industry through the quick turn – over of green forages independent of the

weather and as such ameliorating the adverse effects of season and reduced conflicts between nomadic cattle herders and settled crop farmers. Frequency or rate of watering of the sprouted fodders needs to be determined as once daily has proved to be inadequate.

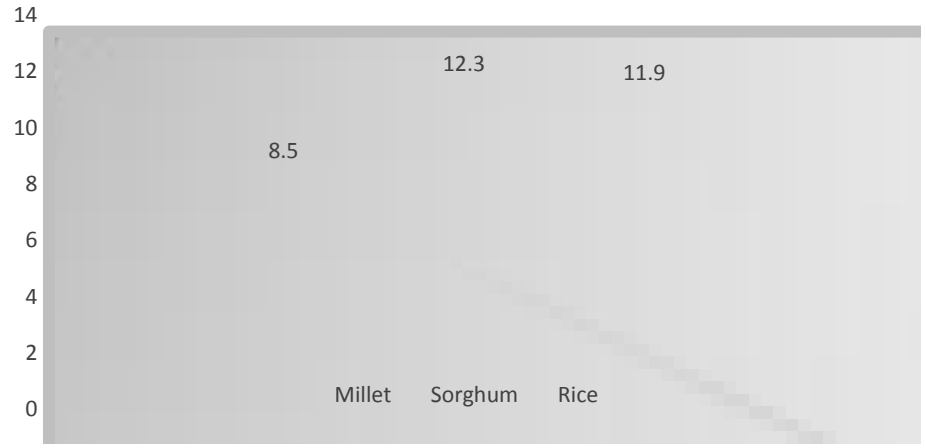


Figure 2: Mean height (cm) of the sprouted grains at 8 days

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