Digitaria horizontalis Willd (Harkiya) An Alternative Fodder for Small and Large Ruminants in Northern Nigeria

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Abstract:- Soilless plant cultivation is the current global research focus due to decreasing land space and increasing human population. This study evaluated a simple modified hydroponic system for the production of *Digitaria horizontalis* Willd, as forage feed supplement. Seeds of the plant were sterilized with 2.5% sodium hypochlorite, rinsed with distilled water and broadcast on the sawdust in a modified Ebb and Flow method. The seeds were irrigated with 1.0 L of Cooper's nutrient solution before germination while the sprouts were watered manually twice daily for fourteen (14) days with 500ml nutrient solution at 0.5 dS m^{-1} and later raised to 1.0 dS m^{-1} at controlled pH. Similar experiments were conducted using Hoagland and Murashige and Skoog nutrient media. A control experimental set up was irrigated with distilled water. The plant did not show significant difference ($p \leq 0.05$) when grown under different nutrient formulations with regards to germination days. However, plant height, number of leaves and leaf area index showed significant difference from Murashige and Skoog nutrient formulations. Number of tillers and total chlorophyll content also significantly differ under the three nutrient formulations. The three nutrient formulations performed better than the control experiment in all the parameters tested. The result of this findings suggests that *Digitaria horizontalis* Willd could be of great potential source of fodder to be exploited as a fodder supplement to enhance large and small ruminant performance using suitable nutrient formulation (hydroponics).

Keywords:- *Hydroponics, Digitaria Horizontalis, Fodder, Ruminants, Proximate Analysis.*

I. INTRODUCTION

Soil is the repository for organic matter, mineral nutrients, water and air required for plants' growth (Powlson *et al*., 2011). For many years, it has been preferred as the growing medium for plants by farmers. However, limitations such as diseases, poor drainage and degradation due to erosion constitute to poor growth of plants. Open Field Agriculture or traditional crop cultivation utilizes large space, labour and large volume of water which limits urban crop cultivation. Likewise, soil based agriculture is now facing other challenges such as urbanization, natural disaster, climate change, indiscriminate use of chemicals and pesticides which is depleting the land fertility (Jayachandran *et al*., 2022). These problems associated with soil and space necessitate soilless cultivation of crops especially for the increasing human population. Soilless plant cultivation termed hydroponics can provide important requirement for growth comparable to field soil. It imitates soil based gardening by using many kinds of growing media such as inorganic substance, organic substance and synthetic substrates (El-Kazzaz and El-Kazzaz, 2017). The concept of hydroponics could be traced to the hanging Gardens of Babylon and the Floating Gardens of China. Ancient men of China, India, Amazon and Egypt used dissolved manure to grow cucumber, water melon and vegetables on riverbeds.

Plethora of literatures have revealed that hydroponic cultivation is gaining global popularity due to efficient resources management and quality food production (Jayachandran *et al*., 2022; Sani *et al*., 2016). The hydroponic fertilizer solution provides not only nitrogen, phosphorus and potassium, but also all of the essential micro-nutrients for plant growth (FAO, 2015). Studies in hydroponics revealed that plants require sixteen elements for growth and these nutrient elements can be supplied from air, water and fertilizer (Jayachandran *et al*., 2022; Kide *et al.*, 2015).

Digitaria horizontalis Willd otherwise called Crabgrass is an annual graminoid, monocot plant of the family Poaceae. The stem is rounded sprawling or erect and branched mostly growing up to 30-75 cm tall with roots at lower nodes (Acevedo-Rodriguez and Strong, 2012). The leaves are linear lanceolate 5-10 cm long and 0.7-1.5 cm wide. They have rough margins, thin and dark green, acute at the tips and rounded or slightly narrowed at the base. The inflorescence is made up of 10-20 hairy spikes (Akobundu *et al*., 2016). It is a fast growing plant that sprouts after first rain in savanna and is eaten highly by both ruminant and non-ruminant animals. The seed of crabgrass remain dormant after a short period when shed from mother plant. Germination occurs when there is an increase in surface temperature above 45F for four to five days. The grass

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has prolific tillering, a single plant can produce 150-700 tillers and 150,000 seeds. *Digitaria horizontalis* Willd is a typical C4 plant thus thriving during hot weather and abundant sunlight.

The aim of this research work was to evaluate a simple modified hydroponic system for Crabgrass (*Digitaria horizontalis* Willd.) production as forage feed supplement in semi-arid Northern Nigeria.

II. MATERIALS AND METHODS

Three different hydroponic solutions were used. These include: The experiment was conducted at College of Agriculture, Hussaini Adamu Federal Polytechnic Kazaure Jigawa State, in the month of May/June, 2019. Ebb and flow method was adopted with modification. A total of 100 plastic trays pinched with small holes underneath and connected to a water hose that drains excess nutrient solution to a large central container. The plastic trays were arranged on wooden benches supported by nails to prevent overturn. Each bench contains 20 trays replicated five times filled with sterilized sawdust. Seeds of *Digitaria horizontalis* Willd (Crabgrass) obtained from NAPRI ZARIA were surfaced sterilized by washing with 2.5% sodium hypochlorite and rinsed several times with distilled water. One hundred gram of seeds (100g) was evenly broadcasted on sterilized sawdust irrigated with 1.0 liter of Cooper's (1979) nutrient solution for germination. The sprouts were watered manually two (2) times in a day for fourteen (14) days with 500ml nutrient solution at 0.5 dS m^{-1}, subsequently, this was raised to 1.0 dS m^{-1} and pH adjusted and maintained at pH 6 throughout the period of the experiment until harvest. Similar set up was done and treated with Hoagland (1938) and Murashige and Skoog (1962) nutrient formulations. A control experiment was set up with *Digitaria horizontalis* Willd seeds (100g) grown on garden soil and irrigated with distilled water.

III. DATA COLLECTION

During growth and at maturity, Crabgrass was subjected to the following measurements:

Number of days to sprouting, 90% sprouts, plant height, number of leaves, number of tillers, proximate composition, fresh and dry weights.

IV. RESULTS AND DISCUSSION

The growth characteristics of *Digitaria horizontalis* Willd under different nutrient formulations are presented in Figures 1 and 2. The results indicated that the plant did not show significant differences at $p \leq 0.05$, when grown under different nutrient formulations with regards to germination days (Figure 1a). Similarly, plant height, number of leaves and leaf area index, revealed similar response under Cooper's and Hoagland nutrient solutions but significantly different from Murashige and Skoog nutrient formulations as shown in Figure 1(b-d), respectively.

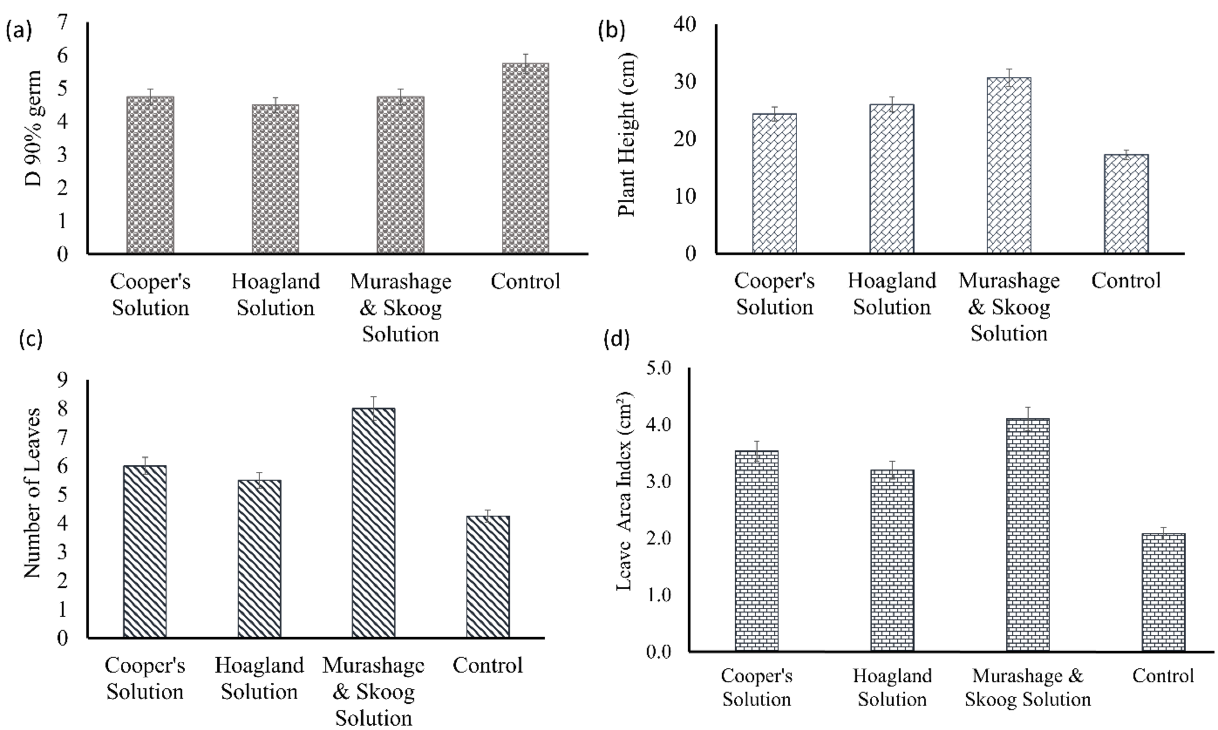

Fig 1(a-d): Growth characteristics of *Digitaria horizontalis* Willd under different nutrient formulations

On the other hand, the number of tillers and total chlorophyll content revealed significant differences at $p \leq 0.05$ under the three nutrient formulations. Murashige and Skoog depicted the highest number of tillers and total chlorophyll content followed by Cooper's nutrient solution, while Hoagland solution had the least performance as illustrated in Figures 2e and f. Nevertheless, all the three nutrient formulations performed better than the control experiment in all of the studied parameters. In a previous studies by Lavres Jnr and Monteiro (2003) and Rodrigues *et al.*, (2007), nitrogen is reported to play an important role for forage grass yield because it positively influences characteristics such as size of the leaves and stems, appearance and development of tillers and root system which are factors directly related to forage. The enhanced performance of *Digitaria horizontalis* Willd in Murashige and Skoog formulation compared with Cooper's and Hoagland could be attributed to its raised concentration of nitrogen as utilizable nitrates. Taiz and Zeiger, (2004) also reported nitrogen to have a central role on forage grass leaf production as a constituent of amino acids, proteins and fundamental enzymes for carbon fixation, and is required in great quantities in the zones of cell division. According to Oliveira *et al*, (2007), Tanzania guinea grass productivity was stimulated under high availability of nitrogen.

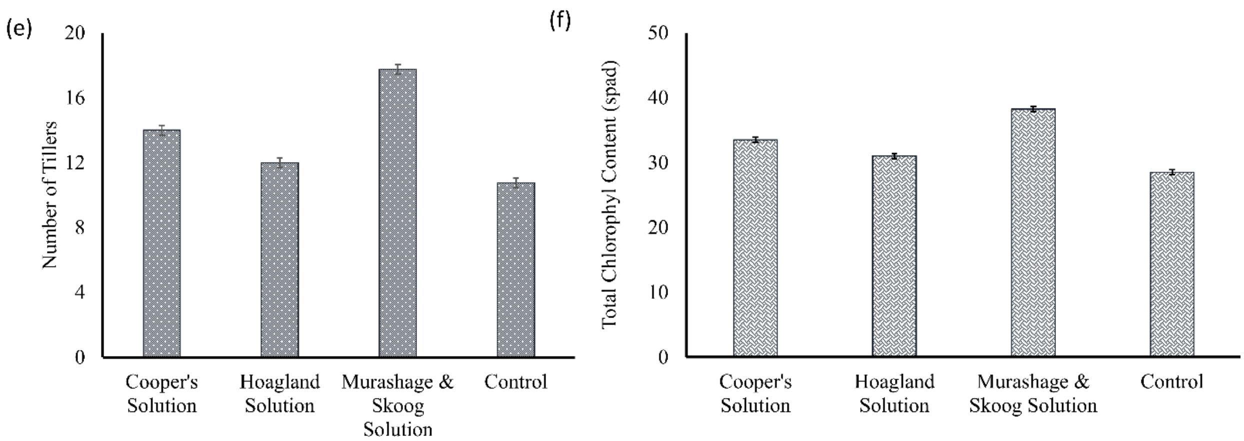

Fig 2e and f: Graphs showing number of Tillers (e) and Total chlorophyll content (f) of *Digitaria horizontalis* Willd under different nutrient formulations

Key: D 90% germ = days to 90 percent germination, Pl height = plant height, L A I = Leaf Area Index, Total Chl. Cont. = Total Chlorophyll Content, No. tillers = number of tillers, No. leaves = number of leaves.

The results of the proximate analysis of *Digitaria horizontalis* Willd grown in different nutrient formulations is presented in Figure 3. It can be clearly observed that the percentage crude protein content of *Digitaria horizontalis* Willd was similar in Hoagland and Cooper's nutrient solutions but significantly different in Murashige and Skoog's media as compared with the control experiment ($p \leq 0.05$). This result shows consistency with the report that crude protein content for most of immature grasses range from 7.2-20.2% of dry matter while that of matured grasses from 5.6-11.5% of dry matter (Shenkute, 1972; Lee, 2018). Crude proteins are essential for growth and tissue repair in animal and their deficiency could result in reduced appetite, low feed intake and poor efficiency of food, which cause lower growth and reduced development of cattle (Lal 2012).

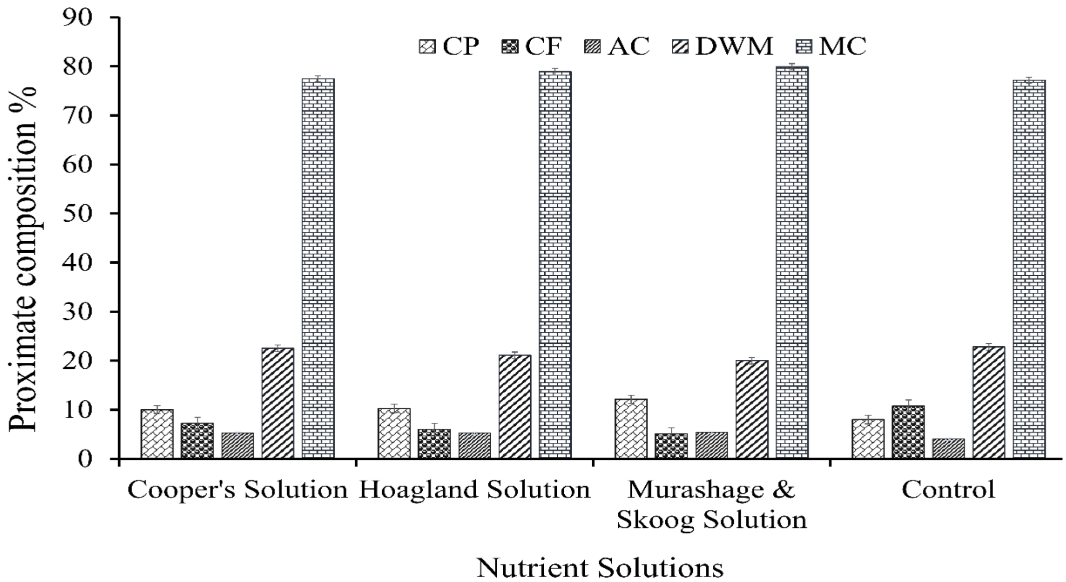

Fig 3 Proximate composition in percentages of *Digitaria horizontalis* Willd grown in different nutrient formulations
Key: CP = crude protein, AC = ash content, DMW = Dry matter weight, MC = moisture content.

The relatively high crude protein values in *Digitaria horizontalis* Willd forage suggests that the plant could support animal production since they exceeded the minimum protein requirement of 10-12% for ruminants (ARC, 1985). Protein is a highly critical nutrient especially in ruminants such as cattle. Protein is required for milk production and reproductive tract reconditioning after calving. Young, growing cattle, in particular, need relatively high levels of crude protein in their diets to support muscle growth (Parish, 2008).

Fibre is another vital nutrient in a cattle diet because it plays an important role in maintaining the rumen function and the cattle health (Abbasi et al., 2018). The crude fiber content of *Digitaria horizontalis* Wild grown in Cooper's nutrient solution was found to be higher than those in Hoagland and Murashage and Skoog but significantly higher ($p \leq 0.05$) than in the control experiment compared to all the nutrient solutions (Figure 2). This finding is in agreement with the findings of Naik and Singh (2014), who reported that maize grown in hydroponic medium produced less crude fiber than the one grown by conventional propagation. Plants grown in a defined environment under controlled conditions tend to be more nutritious and provide higher productivity. Moreover, rapidly growing plants possess high rate of metabolism, thus, do not require high fibre content for cell expansion and multiplication (Naik and Singh, 2014). The percentage ash content of *Digitaria horizontalis* Willd analyzed was not significantly different among the formulations except with the control ($p \leq 0.05$). Comparably, high percentage of ash in the formulations could be associated with the richness of the culture solutions compared with the control. Ash contents defines the mineral elements contained in a sample. However, Ash and dry matter contents were reported to be lower in many hydroponic grasses but with increased moisture content (FAO, 2015). In a recent study, Brownin, (2017), reported a low ash content and dry matter weight in some selected grasses grown under hydroponic.

Dry matter is an indicator of the amount of nutrients that are available to the animal in a particular feed (Fernandes *et al*., 2022). The percentage dry matter weight of *Digitaria horizontalis* Willd in Cooper's solution and the control was not significant ($p \leq 0.05$). This also applies between Hoagland and Cooper's nutrient solutions. Although the dry matter content of *Digitaria horizontalis* Willd grown in Murashige and Skoog formulations was the least but was not significantly different with Hoagland. The low dry matter of *Digitaria horizontalis* Willd in this study (Figure 3) agrees with the reports of dry matter of grasses grown under hydroponic systems as seen in other literatures (FAO, 2015; Kide and Kumar 2015; Brownin, 2017).

The results of the moisture content analysis revealed higher moisture content in hydroponics due to favourable and confined environment. In a related study, Myssa (2016), also reported a similar higher moisture content in barley grown under hydroponics. The results further confirmed that as moisture content in a given plant increases its dry matter decreases. Moisture content of *Digitaria horizontalis* Willd grown in all the nutrient formulations were not significantly different ($p \leq 0.05$) from the control experiment.

V. CONCLUSION

The result of this findings showed that *Digitaria horizontalis* Willd contains essential nutrients and minerals that could be of great potential source of fodder to be exploited as a supplement during the dry season to enhance the proficiency of large and small ruminant performance at all times. Nutrient supplement supplied hydroponically to the growing plants is an important and reliable agro-technique that could be developed locally at an affordable price to provide desirable results against scarcity of land space, minimum water requirement and challenging climatic instability. In essence, it is vital to use hydroponic fodder for small and large ruminant's production with any suitable nutrient formulation as it is cost effective and extremely nutritive. Further research should be developed with other fodder plants for its full exploitation and utilizations throughout the year.

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