COMPARATIVE EFFECT OF SPENT MUSHROOM COMPOST AND NPK FERTILIZER ON THE GROWTH OF *Sorghum bicolor* L. MOENCH AND *Zea mays* L. USING FODDER HYDROPONICS TECHNIQUES

ABSTRACT

The grains of maize and sorghum were converted to grass in the screenhouse for eight days. The treatments evaluated were control (water), spent mushroom compost (SMC), NPK fertilizer, and SN (combination of SMC and NPK). Each treatment was replicated thrice in a complete randomized block design. Growth parameters and nutrient analysis were determined. The effect of organic and inorganic fertilizer was tested on proximate, minerals and digestibility of hydroponics maize fodder (HMF) and hydroponics sorghum fodder (HSF). The study showed significant difference ($P < 0.05$) in all the compositions and parameters except pH values. SN application gave the highest proximate compositions (**%**) of maize-crude-protein (23.66±0.05), maize-moisture (14.62±0.01), maize-CHO (57.86±0.03), maize-NFE (43.96±0.02), maize-fibre (2.44±0.03), sorghum-ash (1.28±0.02), and sorghum moisture (12.56±0.01). NPK gave the highest result of sorghum-crude-protein (18.51±0.04); while SMC gave the highest results of maize maize-crude-fibre (27.71±0.02), maize-fibre (2.22±0.01), maize-ash (3.21±0.01), sorghum-CHO (61.00±0.03) and sorghum-NFE (54.87±0.02). SN gave the highest mineral compositions (mg/100g) of maize-P (155.20±0.02), maize-Ca (34.95±0.08); sorghum-Fe (11.35±0.13), sorghum-P (153.20±0.87), sorghum-Ca (30.00±0.30). NPK gave the best results of maize-Fe (8.00±0.26), maize-Mn (1.55±0.08), and sorghum-Mn (3.40±0.15). There was significant difference in plant heights, fresh weight, dry weight, digestibility, dry matter. The comparative effects of SMC and NPK showed that utilization of SMC, NPK and SN could serves as nutrient supplements for fodder hydroponics used as feed supplements for dairy animals.

Keywords: Fodder, hydroponics, sorghum, maize, SMC, growth, NPK fertilizer, comparative.

1. INTRODUCTION

Hydroponics fodder production is a new technique which involves supplying cereal grains with water and nutrients to enable germination and plant growth in the absence of a solid growing medium. The resulting root mat and green shoot are harvested and fed to dairy animals [1,2,3,4]. The grain responds to the supply of moisture and nutrients by germinating, sprouting and then producing a 200 – 250mm long vegetative green shoot with interwoven roots within 5 to 8 days. Fodder, also called provender, is any agricultural foodstuff used specifically to feed domesticated livestock, such as cattle, rabbits, sheep, horses, chickens and pigs [5,6]. Hydroponics fodder is considered the best livestock feed [7]. The word hydroponics represents two Greek words: hydro which means 'water' and ponic which means 'working'. Hence, hydroponics fodder is the one produced by growing plants in water or nutrient-rich-solution without the use of soil [8].

Hydroponically produced fodder has a short growth period of 7-10 days and requires a small piece of land for production [9]. The practice of hydroponics is important due to problems faced by dairy farmers such as land tenure system, water scarcity, insufficient quality fodder seeds, less labour availability and cost, unavailability of fodder throughout the year and so on [10,1]. A range of cereals can be utilized for fodder production, these include sorghum, barley, oats, wheat and maize. Sorghum and maize fodder systems are the focus within this report. According to [7,11,12] there is a range of chemical and structural changes that take place within the cereal grain through the hydroponic growing process. Activation of enzymes within the grain leads to hydrolysis of proteins, carbohydrates and lipids into their simpler components. This hydrolysis increases the concentrations of amino acids, soluble sugars and fatty acids within the grain and resulting shoot. Additionally, as the fodder is grown within a shed, there are no losses of water due to evapotranspiration. The companies that market hydroponics fodder systems make many claims about hydroponics fodder as superior livestock feed, better gain, improved fertility, earlier heat cycles, improved fleece quality, improved immunity, better behavior, temperament and less manure, etc. but few of these claims have been proven to be repeatable in experiments [13]. Spent mushroom compost (SMC), otherwise known as the spent mushroom substrate, is the leftover of wastes after different flushes of mushroom have been harvested [14]. It was noted that the use of agro-waste as a source of plant nutrients serves as environmental sanitation as well as reduction in craving for mineral fertilizers by farmers. [15,16] reported that the SMC was entangled with innumerable mushroom threads collectively referred to as mycelia which could have modified the substrate biochemically by production of enzymes. Sprouting grains for human consumption has been used for centuries in Asian countries to improve food value [17]. Germination and sprouting activate enzymes that change the starch, protein, and lipids of the grain into simpler forms, for example, starch changes to sugars. There are some arguments about the sprouting grains for convenience of green forage production in hydroponics system to compensate the feed resources for animals [18]. According to [19,20] there was increase in the degradation rates of fodder when compared to other concentrates, suggesting a possible increase in total milk production due to higher feed intakes over time. In fact, the only species which is designed to eat grains is birds because they have a sprouting unit in their body called crop. A crop has a temperature and moisture which eliminates phytics. Elimination of phytics inhibitors means more mineral absorption and feed becomes very absorbable. The more enzymes you have in feed the healthier and long living the animals. If the feed does have enzymes then the compensation has to be made by the pancreases meaning the animal will have to overwork the pancreas, which requires more energy requirement [21,22].

Forage and fodder crops include pasture and range vegetation, as well as crop residues derived from farm crops. Nigeria has a land area of 92.4 million hectares of which about 44% are under permanent pastures, which supports its domestic ruminants of over 101 million [23]. It is estimated that only about 3% of this number of animals are reared on improved pastures; the remaining 97% are raised on low nutrient native pastures and farmlands [13]. The implication of this is the low output of animals per unit area. This situation is of particular concern, especially in view of the very low animal intake of 10g per caput per day, as against the Food and Agricultural Organization’s recommendation of 36 g per caput per day, in comparison to Nigeria’s rising human population which is currently about 140 million. Also, inadequate number of forage scientists to conduct necessary research in the various aspects of forage and fodder crops has slowed down development in this area. Most indigenous forage and fodder species are low in yield and nutritive value [24,25,13,]. In spite of the infertile soils and hostile climatic environment, ruminant livestock in Nigeria have depended largely on the extensive native pastures, browse on farm crop residues across the country. According to [26] forage quality and availability in Nigeria vary greatly from wet season to dry season which however, affect the output of the animals. These animals provide power, transport and most of the meat for human consumption, as well as the various valuable by-products such as bones, blood, hides and skin for the nation's industrial growth. Improvement is however needed in the production of these feeds in order to meet the increasing demands of a growing population. To meet up with the daily demands of feed by these animals and to enhance the quality of this techniques, this study therefore investigates the comparatives effects of SMC and NPK on fodder Hydroponics techniques using sorghum and maize thus, encourages the use of organic fertilizer rather than inorganic fertilizer.

2. MATERIALS AND METHODS

2.1 Collection of SMC fertilizer and planting materials:

Seeds of sorghum were purchased from the local market of Bodija, Ibadan, Nigeria. The Seeds were subjected to germination test, the viability was checked before usage, trays with dimensions of 47cm x 23.5cm x 4.2cm, length, width and height respectively were used. NPK fertilizer (15:15:15kg) was purchased from an agro-chemical shop in Ibadan, Nigeria. The spent mushroom composts utilized were obtained from Department of Pathology, Federal Research Institute of Nigeria,

2.2 Pre-planting Analyses:

The mineral element compositions of the SMC were determined before their application. This was done to know the various elements that were present in the spent mushroom substrate before usage. The mineral element analyses were carried out using the procedures of [27].

2.3 Preparation of SMC

This was done according to the method of [28]. Spent mushroom composts were dried and then powdered with the help of electric blender. The powders were soaked in a sterile distilled water for 24 hours at the rate of 35g/100ml and converted to aqueous form. To remove large particles, the extracts were filtered through Whatman filter paper.

2.4 Treatment and Experimental Design

Four treatments were used per plant (maize and sorghum) and each treatment was replicated thrice.

The treatments are:

Control = Water only

SMC= Spent mushroom compost

NPK=15:15:15 fertilizer

SN = Combination of SMC and NPK

2.5 Planting Methods

Clean seeds of sorghum and maize, free from debris and other foreign materials were sterilized by soaking for 30 minutes in 20% sodium hypochlorite solution to control the formation of mold and fungus [29]. The seeds were washed thoroughly from residues of bleach and re-soaked in tap water for about 4 hours [30] and then transferred into a bucket for 48 hours with punched holes on its cover to allow easy access to oxygen, and then distributed in a tray of 47cm x 23.5cm x 4.2cm, length, width and height respectively. The trays with holes at the base allow draining of excess fertilizer on the grains, then the seeds were evenly distributed on the tray [31]. Inside the screen house, the plants were allowed to grow for 8 days after which the green fodder were harvested. A daily random sampling of twenty-four trays were performed at approximately the same time for 7days [12]. 300 grams of sorghum and maize grain were sown in the planting trays lined up on the screen house bench with holes at the bottom to allow drainage of excess water. The steeped seed of sorghum and maize were carefully weighed to have approximately the same number of seeds per tray. The trays were stacked on the screen house bench with a slight slop which allows drainage of excess water. 24 trays were irrigated manually with tap water twice a day (early in the morning and in the evening) at a fixed rate of 600 ml per day which was enough to keep the seedlings moist [30]. The application of fertilizers was done thus: SMC (0.6grams tray-1), NPK (0.33grams tray-1), and SMS/NPK (2: 1), application of fertilizer was done twice before the end of the 8 days (after seed sprouting and the fourth day)

The experiment was terminated after 8 days of germination of green fodder when the fodder biomass was ready for harvest [11]. At harvest time, fresh weight and dry weight were computed for sorghum and maize [32]. A representative fresh plant samples (about 150 grams) from every tray was taken at harvest, dried at room temperature and was used for determination of dry matter and nutrient changes in the sprout over the period of 8 days. [12]. The first sprouting leaf was pegged on each tray and the heights were measured and recorded.

2.6 Nutrient Analyses:

2.6.1 Proximate Analyses

Hydroponics samples were collected and oven-dried at 70°C for 48 hours, weighed and analyzed using the proximate analysis procedure. Proximate analysis for collected samples was conducted for crude protein, carbohydrate, crude fiber, ash, crude fat and moisture content [33].

2.6.2 Digestibility Determination

In vitro fresh matter digestibility determination was carried out on green fodder of sorghum and maize which was modified into two-stage digestion technique. The modified procedure of [34] was used in partitioning of cell-wall component into Acid Detergent Fibre (ADF), which comprises lignin, cellulose and insoluble ash (minerals) as the difference between ADF and Acid Detergent Lignin (ADL) to which ash was added. Gross energy was determined using an Adiabatic Bomb Calorimeter.

Procedure:

1. Fodder samples were weighed into a glass flask.
2. Buffers, macro and micro-minerals were added along with rumen fluid extracted from a cow fit with a ruminal cannula.
3. The forage, buffers and rumen fluid were incubated in a waterbath in an anaerobic environment (carbon dioxide) at a cow's body temperature (102 F) for 48 hours.
4. The flask containing the forage sample, buffers and rumen fluid were removed from waterbath and the remaining solution was refluxed in NDF solution for 1 hour.
5. The remaining solution was filtered and the NDF that resisted digestion by rumen bacteria was retained on the filter.
6. Digestible NDF was calculated.

2.6.3 Mineral Analyses

The mineral analyses were done at the Department of Human Nutrition, University of Ibadan, Ibadan, Nigeria. Atomic Absorption Spectrophotometer was used to measure the mineral contents (Ca, Mg, Fe, K, and P.)

Procedure

Atoms of an element were vaporized and atomized in the flame. The atoms then absorbed the light at a characteristic wavelength. The source of the light is a hollow cathode lamp, which is made up of the same element, which has to be determined. The lamp produces radiation of an appropriate wavelength, which while passing through the flame was absorbed by the free atoms of the sample. The absorbed energy was measured by a photo detector read-out system. The amount of energy absorbed was proportional to the concentration of the element in the sample. Different electrode lamps were used for each mineral. The equipment was run for standard solutions of each mineral before and during determination to check if was working properly. The dilution factor for all minerals except P and Mn was 100. For determination of Mn, further dilution of the original solution was done by using 0.5mls of original solution and enough distilled water was added to it to make the volume up to 100ml. Also, for the determination of Ca, 1.0 ml lithium oxide solution was added to the original solution to unmask Ca from Mn. The concentrations of minerals recorded in terms of "ppm" were converted to milligrams (mg) of the minerals by multiplying the ppm with dilution factor and dividing by 1000, as follows:

$$\mathrm{MW} = \frac{\mathrm{Absorbancy\ (ppm)} \times \mathrm{Dry\ weight} \times \mathrm{D}}{\mathrm{Weight\ of\ sampl} \times 1000}$$

Calculation: Percent Total Dry Matter (Total DM)

$$\%\ \mathrm{Total\ DM} = \frac{W_6 - W_4}{W_5 - W_4} \times 100$$

Where W_4 = Tare weight of tray

W_5 = Initial weight of fodder sample and tray

W_6 = Dry weight of fodder sample and tray [32].

2.6.4 Determination of pH Values

The pH value was determined using pH meter at Physiology Laboratory, Department of Botany, University of Ibadan, Nigeria.

Procedure

Samples (5g) of maize and sorghum fodder hydroponics were meshed and soaked in 100ml of distilled water for 24 hours. pH meter was calibrated to appropriate settings and standard buffer of 7.00 was used. The pH meter was inserted into the beaker containing the sample to get the accurate value. The readings were determined and recorded for each sample.

2.7 *Statistical Analysis*

Data generated were statistically analyzed using analysis of variance (ANOVA). Means were computed following DMRT at 5% level of significant.

4. RESULTS

Table 1 showed the effects of SMC and NPK fertilizer on the proximate compositions (%) of maize and sorghum fodder hydroponics. Crude protein level of hydroponics maize and sorghum fodders ranged from 22.81 - 23.66 and 23.05 – 23.85 respectively. Crude fibre ranged from 26.82 - 27.71 and 18.39 - 18.51 respectively. Fat content ranged from 2.08±0.01 - 2.22±0.01 and 2.12±0.03 - 2.44±0.03 respectively. Moisture content ranged from 14.23±0.01 - 14.62±0.01 and 12.10±0.01 - 12.56±0.01 respectively. CHO ranged from 56.79±0.03 - 57.86±0.03 and 60.10±0.03 - 61.00±0.03 respectively, while NFE ranged from 43.29±0.02 - 43.96±0.02 and 53.92±0.02 - 54.87±0.02 respectively.

Table 2 showed the effects of SMC and NPK on the mineral compositions (mg/100g) of green fodder hydroponics of maize and sorghum. The Fe amount of hydroponics maize and sorghum fodders ranged from 4.00±0.15 - 8.00±0.26 and 9.10±0.28 - 11.35±0.13 respectively. Mn ranged from 0.9±0.05 - 1.55±0.08 and 2.25±0.13 - 3.40±0.15 respectively, while Ca ranged from 21.55±0.10 - 34.95±0.08 and 22.95±0.05 - 30.00±0.30 respectively.

Table 3 showed effect of SMC and NPK on plant height, fresh weight (g), dry weight (g), and total weight (g) of maize and sorghum. The fresh weight of hydroponics maize and sorghum fodders ranged from 700±100.0 - 900±81.45 and 700±100.00 - 950±125.83 respectively. Dry weight ranged from 300±29.13 - 450±76.05 and 190±10.00 - 350±76.43 respectively. Plant height ranged from 9.8±0.36 - 13.5±0.38 and 13.2±0.38 - 17.0±0.40 respectively.

Table 4 showed the comparative effects of SMC and NPK on digestibility, dry matter and pH of maize and sorghum fodder hydroponics. The fresh weight of hydroponics maize and sorghum fodders ranged from 700±100.0 - 900±81.45 and 700±100.00 - 950±125.83 respectively. Dry weight ranged from 300±29.13 - 450±76.05 and 190±10.00 - 350±76.43 respectively; while plant height ranged from 9.8±0.36 - 13.5±0.38 and 13.2±0.38 - 17.0±0.40 respectively.

5. DISCUSSION

There is a wide range of claims regarding the yield of hydroponics fodder systems. This study more or less shows that hydroponics fodder is the best compared with naturally growing fodder [10,35,24]. In this study, there was a significant difference ($P < 0.05$) in proximate compositions comparing the controls with the treatments of maize and sorghum fodders. This result is in conformity with the work of [17]. NPK and SN gave a better increase compared with SMC. This is supported by the work of [36]. Crude protein level of hydroponics maize and sorghum fodders ranged from 22.81% - 23.66% and 23.05% – 23.85% respectively. This increase could be due to enzymatic activities enhancement of nutrients which reduces the rate of dry matter and this involves loss of carbohydrate through respiration during germination of the tender plant and thus, longer plant sprouting time is responsible for greater losses in fresh matter and the increase facilitates the metabolism of nitrogenous compound and thus increase the crude protein levels [1]. The result of crude protein in this study is higher than the data reported by [37] on hydroponics maize fodder. The crude fibre (CF) of maize ranged from 26.82% - 27.71% having its best performance at treatment SMC and that of sorghum ranged from 18.39% - 18.51% having its best performance at treatment NPK. This result is less compared with the crude fibre level of finger millet reported to be 27.41% [31,38]. The reason could be due to difference in plant variety, climatic factors such as temperature and humidity [39]. The small quantity of fat content of maize and sorghum fodders suggests its health and nutritional benefits to animals. The fodder fat consists mostly of unsaturated fatty acids, which are less harmful health than the saturated fatty acids of animal fats [39]. The high moisture content (14.62±0.01) suggests the freshness and palatability of the fodders. The high carbohydrate content (60.39±0.03) of both maize and sorghum indicates the high energy ability of the plants being cereals. The nitrogen free extracts (NFE) of hydroponics maize and sorghum fodders ranged from 43.29% - 43.96% and 53.92% - 54.87% respectively. This result is less than the one got by [31,40] as 68.48% on hydroponics maize fodder (HMF). In this study, the results of crude fiber, crude protein, ash, moisture, total carbohydrate and nitrogen free extracts of maize and sorghum fodder hydroponics are in agreement with [41,42] who reported that hydroponics fodder has high feed quality that is rich in proteins, fibers, vitamins, and with health beneficial effects on animals.

In this research, there were significant differences ($P < 0.05$) in the mineral compositions of maize and sorghum when controls are compared with the treatments. These changes in the mineral contents of maize and sorghum hydroponics fodders were probably enhanced and influenced the quantity of water [43,1] and sprouting allows the minerals more available by chelating with protein [44]. Also, this variation might be due to the reason that the amount of minerals in mushrooms of the same species is directly related to factors such as origin, species and/or strains and cultivation conditions, genetic factors, substrates and distance from pollution sources [39,45]. This study has shown that NPK and SN on maize and sorghum increases the mineral level of fodder plant thus, the mixed feed of maize and sorghum fodder hydroponics could be a vital source of mineral for animal feed. This findings are in agreement with previous researchers who have reported increase with organic fertilizers on mineral contents [46]. The increase in iron and phosphorus content of sorghum and maize respectively with the application of SN could be due to uptake of phosphorus in the SMC and NPK fertilizer and this is in support with the research done by [47] who reported that most phosphorus absorption increased with an increase in phosphorus application throughout the growth stages. The importance of mineral elements in human, animal and plant nutrition has been well recognized. Deficiencies or disturbances in the nutrition of an animal causes a variety of diseases and can arise in several ways. The presence of mineral elements in animal feed is vital for the animal's metabolic processes. Grazing livestock from tropical countries often do not receive mineral supplementation except for common salt and must depend mostly on fodder plant [48].

In this study, we found out that there was a significant difference in fresh weight, dry weight and plant height of maize and sorghum fodders on eighth day of planting. The increase in fresh weight could be attributed to imbibition of water constituting up to 80-90% of the fresh weight of green fodder [49]. Hence, increasing the moisture contents in the fodder and consequently the corresponding increase in the fresh weight [36,38]. The increase in fresh weight is in conformity with the findings of [32,50,51,52,53,54,55] who reported that the yield of fodder hydroponics ranges from 6 to 10 times the weight of green fodder harvested relative to the weight of the initial grain planted. This result is also in line with the work of [56,57,58,59] who reported that farmers producing hydroponics maize fodder under low cost device revealed fresh yield of 8-10kg from 1kg locally grown maize seeds in 7-10 days. The embedded seeds in the root mat of maize compared to total degradation of sorghum seeds suggests the reason for increase in dry weight (g) of maize compare to sorghum. The increase in plant height was because of the addition of SN and NPK which is a reservoir of nutrients to the fodders.

This study shows significant difference in digestibility and dry matter of maize and sorghum across the treatments with SN being the highest digestibility in maize (71.10±0.68) and sorghum (67.02±0.61). The increase in the digestibility of dry matter might be due to the tenderness of the fodder at early age. The result of digestibility agrees with the data reported by [60,61] which indicated that the digestibility of nutrient has been increase by using sprouted grain in the diet of broiler and large animals. The increase in dry matter and dry weight of maize in this study is in consonance with the report on maize fodder hydroponics by [62] who reported that hydroponics maize fodder is palatable and the germinated seeds in the roots are consumed by animal along with the leaves of the fodder plants without any wastage and this seeds could have been the reason for the increase in dry weight and dry matter compare to degradation of sorghum grain after 8th days of sprouting.

The pH values of maize and sorghum fodders which ranged from 6.61 – 6.95. This pH which is neutral accounts for its health and nutritional benefits and consumption without any harm.

6. CONCLUSION

Fodder hydroponics is one of the most important agricultural techniques currently in use for green fodder production in many countries [63]. The positive effect of SMC and its combination with NPK suggests an improvement in nutrient composition of maize and sorghum fodder hydroponics [40]. The study showed that performance of SMC fertilizer on dry matter, total weight, total carbohydrate and NFE on maize and sorghum fodder hydroponics suggests its efficiency as a source of energy for dairy animals. The performance of SN on mineral composition of maize and sorghum fodder hydroponics confirms its usage as nutrient supplement in fodder hydroponics. There is therefore an evidence that improved nutrient of fodder hydroponics maize and sorghum with the application of SMC as organic fertilizer in fodder hydroponics could provide a consistent feed supply, source of energy, nutritive feeds and easy access to feed in area where there is pervasive dry environment.

7. RECOMMENDATION

Fodder hydroponics is a high fresh feed for poultry birds and livestock's animals, grown in a hygienic environment, thus can be used as feeds supplement by livestock farmers. Moreover, it is still a new aspect of farming techniques in many countries of the world. This technology can be utilized to boost agricultural production if done on large scale and embraced by researched institutes and livestock farmers. This will be a major contribution to the development in the agricultural industry. Further research is needed to develop low cost device for fodder hydroponics production thus must be embraced by researchers globally.

Abbreviations and meanings: maize-crude-protein – MCP, maize CHO – Mcho, maize NFE – mNFE, sorghum fat – SF, maize ash -MA, sorghum moisture – SM, sorghum CHO – sCHO, sorghum crude protein SCP, maize fat – MF, maize ash – MA, sorghum NFE – sNFE

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Table 1: **Effect of SMC and NPK Fertilizer on the Proximate Composition of Maize and Sorghum Fodder Hydroponics (%)**

Fodder Plant	Treatment	Control	SMC	NPK	S.N.
Maize	Crude protein	22.81±0.05[a]	23.64±0.05[b]	23.54±0.05[b]	23.66±0.05[b]
	Crude fibre	26.82±0.02[a]	27.71±0.02[b]	27.40±0.02[b]	27.14±0.02[b]
	Fat	2.08±0.01[a]	2.22±0.01[b]	2.19±0.01[b]	2.13±0.01[b]
	Ash	3.02±0.01[a]	3.21±0.01[c]	3.13±0.01[b]	3.12±0.01[b]
	Moisture	14.23±0.01[a]	14.23±0.01[a]	14.32±0.01[a]	14.62±0.01[a]
	CHO	56.83±0.03[a]	56.79±0.03[a]	56.85±0.03[a]	57.86±0.03[b]
	NFE	43.44±0.02[a]	43.29±0.02[a]	43.77±0.02[a]	43.96±0.02[a]
Sorghum	Crude protein	23.05±0.01[a]	23.32±0.01[a]	23.85±0.01[a]	23.42±0.01[a]
	Crude fibre	18.41±0.04[a]	18.39±0.04[a]	18.51±0.04[a]	18.42±0.04[a]
	Fat	2.12±0.03[a]	2.39±0.03[a]	2.42±0.03[a]	2.44±0.03[a]
	Ash	1.28±0.02[b]	1.23±0.02[a]	1.27±0.02[b]	1.28±0.02[b]
	Moisture	12.10±0.01[a]	12.23±0.01[a]	12.42±0.01[a]	12.56±0.01[a]
	CHO	60.22±0.03[a]	61.00±0.03[b]	60.10±0.03[a]	60.39±0.03[a]
	NFE	53.92±0.02[a]	54.87±0.02[b]	54.02±0.02[b]	54.65±0.02[b]

* Means with different superscript in each row are significantly different ($P < 0.05$) Means are replicate of three values.

Table 2: Effects of SMC and NPK Fertilizer on Mineral Composition of Maize and Sorghum Fodder Hydroponics

Fodder	Treatment	Control	SMC	NPK	S.N.

Plant (DM)	(mg/100g)				
MAIZE	Iron (Fe)	6.30±0.12[b]	4.00±0.15[a]	8..00±0.26[d]	7.90±0.25[c]
	Phosphorus (P)	141.50±1.04[a]	138.40±0.58[a]	134.10±0.81b[a]	155.20±0.02[b]
	Manganese (Mn)	1.30±0.13[b]	0.9±0.05[a]	1.55±0.08[d]	1.50±0.18[c]
	Calcium (Ca)	24.95±0.52[b]	23.90±0.60[b]	21.55±0.10[a]	34.95±0.08[c]
SORGHUM	Iron (Fe)	10.75±0.08[b]	9.10±0.28[a]	9.95±0.15[a]	11.35±0.13[c]
	Phosphorus (P)	120.30±0.30[b]	142.94±0.02[b]	143.23±0.26[b]	153.20±0.87[a]
	Manganese (Mn)	2.25±0.13[a]	3.00±0.13[b]	3.40±0.15[c]	3.04±0.16[b]
	Calcium (Ca)	22.95±0.05[a]	23.50±0.10[a]	25.00±0.10[b]	30.00±0.30[c]

* Means with different superscript in each row are significantly different ($P < 0.05$) Means are replicate of three values

Table 3: Effects of SMC and NPK on Plant Height, Fresh, Dry and Total Weight of Maize and Sorghum Fodder Hydroponics

Fodder (DM)	TREATMENT	CONTROL	SMC	NPK	S.N.
Maize	Fresh weight(g)	700±100.0a	750±57.74[a]	900±81.45[c]	850±160.72[b]
	Dry weight(g)	300±29.13[a]	400±50.00[b]	450±76.05[b]	350±50.00[a]
	Plant height(cm)	11.7±0.20[b]	11.6±0.61[b]	9.8±0.36[a]	13.5±0.38[c]
Sorghum	Fresh weight(g)	800±144.34[b]	950±125.83[c]	900±152.75[c]	700±100.00[a]
	Dry weight(g)	200±28.78[a]	300±60.85[b]	350±76.43[b]	190±10.00[a]
	Plant height(cm)	13.2±0.38[a]	15.2±1.50[c]	14.6±1.26[b]	17.0±0.40[d]

* Means with different superscript in each row are significantly different ($P < 0.05$) Means are replicate of three values

Table 4: Effects of SMC and NPK on Digestibility, Dry-matter and pH of Maize and Sorghum Fodder Hydroponics on Dry-matter Basis

Fodder (DM)	TREATMENT	CONTROL	SMC	NPK	S.N.
Maize	Digestibility (%)	64.19±0.12[c]	47.13±0.33[a]	56.87±0.14[b]	71.10±0.68[d]
	Dry Matter (%)	185.00±60.81[a]	350.50±76.43[c]	180.00±10.00[a]	250.50±28.78[b]
	pH	6.72±0.07[a]	6.95±0.11[a]	6.64±0.04[a]	6.61±0.06[a]
Sorghum	Digestibility (%)	53.33±0.54[a]	64.54±0.16[b]	58.80±0.42[a]	67.02±0.61[b]
	Dry Matter (%)	42.89±10.31[b]	58.41±16.03[c]	30.06±4.02[a]	28.57±0.91[a]
	pH	6.89±0.12[a]	6.79±0.08[a]	6.84±0.15[a]	6.93±0.06[a]

*Mean with different superscript in each row are significantly different (P<0.05). Means are replicate of three values