GROWING OF HYDROPONIC MAIZE FODDER USING LOW COST GREEN HOUSE CULTIVATION

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ABSTRACT

The study was conducted at Duware research farm, is a private research farm located 2km away from Yola South Metropolis. The study evaluated the method of Growing Hydroponic Maize Fodder Using Low Cost Green House Cultivation, the objectives of this research are to adverse the force seep problems through these methods first: Harvesting of hydroponic maize and biomass production. Second: Impact of environment on growing hydroponic maize fodder, the following are impact of environment on growing hydroponic maize fodder; Light Intensity, Temperature and Air Humidity. Third: challenges of growing hydroponic maize fodder involves the following; Prevalence of mold, Management and Irrigation. The following are method for growing hydroponic maize; Sources of maize seeds, Seeds storage, Washing and removal of chaff from maize seeds, Treatments of seeds and improvised silver aluminum trays, soaking of maize seeds, Incubation period of maize seeds, planting of maize seeds, Seeds rate, Preparation of calcium nitrates Ca $(NO_3)_2$ and Harvesting of hydroponic maize. This study revealed that hydroponic greenhouse cultivation is better option in the utilization of inputs and improved maize production. The irrigated water used for growing hydroponic maize should be replaced after every 3 days to reduce microbial contamination in maize, Seeds should be soaked in fresh water for different periods; 4h, 8h, 12-16h and 24h depending on the hardness of the seed coat for proper growth and development of hydroponic maize and the green shed is important for lighting to prevent yellowing of the leaves because green shade net allows sufficient light and maintain favorable temperature and humidity for optimum photosynthesis which results to better yield of hydroponic maize. In conclusion, hydroponic system minimizes water wastage since it applied directly to the roots and is often recycled and used several times and about 1.5 – 2 liter are needed/ required to produce 1 kg of green maize hydroponically, it is recommended that green shed is important for lighting to prevent yellowish of the leaves because green shade net allows sufficient light and maintain favorable temperature and humidity for optimum photosynthesis which results to better yield of hydroponic maize.

KEYWORDS: Maize seeds, Water, N; P: K fertilizer, calcium nitrates $Ca(N0_3)_2$ and Maize fodder

DESCRIPTION OF PROBLEM

The greatest challenge our agriculture production system facing worldwide are maintaining the productivity levels with changing climate and depleting soil fertility. To mitigate these adverse effects of climate and soil fertility offers the opportunity to develop a sustainable system (1).Traditional/ conventional feeds production requires a major investment for the purchase of land, in addition to investment in agricultural machineries, equipment and infrastructure required for pre and post – harvesting including handling, transportation and conservation of feeds; it also requires labor, fuel, lubricant, fertilizer, insecticide, pesticides and herbicides for good production of maize (2). As an alternative to conventional method, grains can be grown with hydroponics technology within seven to eight days. The term 'Hydroponics' was derived from Greek word '*hydro'* means water and '*ponos'* mean labor. Hydroponics is a modern agriculture technique that uses nutrient solution rather than soil for crop production as described by (3). (4) revealed that the conventional feed and

feeds resources are not enough to bridge this gap. The research is focused to addressed the following challenges as follows: to describe the method of growing hydroponic maize fodder, to determine the impact of environment on growing hydroponic maize fodder and to identify the challenges and possible solution of growing hydroponic maize fodder.

MATERIALS AND METHODS

Study Area

The study was conducted at Duware research farm, is a private research farm located 2km away from Yola South Metropolis. Yola South Local Government has area of 718km^2. The Local Government was bounded to the North by Yola North and Girei, East and South by Fufore and to the West by Demsa Local Government areas of Adamawa State.

Management of hydroponic maize seed

Fresh water was sprayed for five (5) days on the sprouted seeds while liquid solution of N.P.K and calcium nitrates $Ca(NO_3)_2$ was sprayed on day 6th with (0.6ml of N.P.K + 1ml of Ca $(NO_3)_2$, 0.4ml of N.P.K + 2ml Ca $(NO_3)_2$ (on day 7th) and 0.2ml of N.P.K+ 3ml $Ca(NO_3)_2$ (on day 8th) and this solution were withdrawn on day 8th late in the evening prior to harvest (on day 9th) using knapsack sprayer to spread evenly on each surface of sprouted maize, and it was kept moist, not dried or flooded. The perforated trays were irrigated manually with hydroponics nutrient solution twice a day (07:30am and 5:30 pm) at a fixed rate of 300 ml/tray/day using knapsack sprayer for 15 minutes. Drained water was collected and measured for the total dissolved solid of calcium nitrate $Ca(NO_3)_2$ and N.P.K fertilizer solute on using TDS meter against infestation.

RESULTS AND DISCUSSION

Method of growing hydroponic maize seed

Step1: Materials used for growing hydroponic maize seed

The equipment and materials used were; improvised silver aluminum tray, clean drinking water from the tap, calibrated bucket (10 liters), Knapsack sprayer for irrigation of water, commercial liquid fertilizer (N.P.K) and solid calcium nitrates $Ca(N0_3)_2$. Viable seeds (white maize seeds), Knife, large calibrated plastic container (for treatment of maize seeds), Gunny/ jute bags, measuring cylinder and hands gloves.

Step 2. Devices used

Devices used in hydroponic house/unit were; Hygrometer to measure humidity, thermometer to measure the temperature, weighing scale used to measure the maize seeds before soaking and after harvest, Pocket pH meter to measure the water pH and TDS meter to measure the total dissolve solid $(Ca(N0_3)_2$.

Table 1: Total dissolves solid (TDS), pH and temperature of hydroponic maize

Nutrients solution	T_1 (5th day) Raised on water only	T_2 (6th day) Water + Nutrient solution	T_3 (7th day) Water+ Nutrient solution	T_4 (8th day) Water+ Nutrient solution
TDS at temp before irrigation	131.2at 24^{0}C	131.0 at 24^{0}C	131.3 at 24^{0}C	131.2 at 24^{0}C
TDS at temp after irrigation	162.3at 26^{0}C	185.1 at 26^{0}C	187.3 at 26^{0}C	198.2 at 26^{0}C
pH Level	6.5	6.4	6.3	6.2

Step3: Sources of maize seeds

White maize (Zea mays) grains were procured from Yola South Local Market of Adamawa State. The grains were subjected to seed selection and treatment to check their viability before use as described by (5).

Step4: Seeds storage

Seeds were sun dried a day prior to seeds washing; broken seeds and foreign materials were removed and seeds were kept in a dry and safe place (6).

Step 5: Washing and removal of chaff from maize seeds

Four (4) kg of white maize seed were washed properly with 10-12 liters of water by scrubbing using stick; the seeds settled down after 5 minutes. Light seeds floated on top of water were removed, all dirt and poor –quality seed are removed, grains were stirred manually using wooden stick, the water was then drained completely and the process was repeated till broken and dead seeds were removed completely. After removing all unwanted materials, the quantity of seed remained was 3.5kg which was measured after seed cleaning.

Step 6: Treatments of seeds and improvised silver aluminum trays

White maize grain (4kg) was treated by diluting 15ml (20%) of sodium hypochlorite solution (domestic hypo) with 4 to 5 liters of clean water. which provided the concentration needed for sanitizing the seeds? The seeds were washed thoroughly after treatments for 30 minutes using 10-12 liters of clean water to remove the impurities using hypochlorite solution. Planting trays were washed with diluted hypochlorite solution and disinfected before and after harvest as reported by (7).

Step 7: Soaking of maize seeds

Clean water was measured using instruments known as TDS meter and pocket pH meter before used. Four kilogram of maize grains were weighed using weighing scale; the grains were soaked and submerged completely in clean water of 7 to 8 litres using 10 litres calibrated rubber bucket; the seeds remained for a period of 4-8 hours. After 8 hours, the water was drain and collected to measure the total dissolved solid using TDS meter and pH as reported by (8).

Step 8: Incubation period of maize seeds

After soaking the seeds for ax period of 8 hours, the wet seed was transferred directly inside clean dry fumigated jute bag, the seeds remained inside the bags for a period of 24 hours (incubation). The bag was kept away from direct sunlight to avoid sun drying of the seeds, a quantity of 8 to 10 liters of clean water was sprinkled to the seeds after every 2-3 hours to kept it wet as revealed by (9).

Step 9: Planting of maize seeds

After 24 hours of incubation period, germinated seed (sprouted seed) was transferred immediately to clean improvised silver aluminum trays. The perforated part was made to drain out excess amount of water during irrigation. The drained water was collected with aid of a calibrated rubber container to measure the total dissolved solids of nutrient solution of Ca $(NO_3)_2$ and N.P.K fertilizer after irrigation.

Step10: Seeds rate

The recommended seeding rate for production of hydroponic maize was 6.4 to 7.6kg/$m^{2.}$ The seed was placed 3cm/tray high for proper sprouting/germination of hydroponic which were consistent with 3.5cm/tray. High density may result to more chances of microbial contamination in the root mat which affects the growth of the sprouted maize seed.

Step 11: Preparation of calcium nitrates $Ca(NO_3)_2$

Solution form of solid calcium nitrates was prepared by adding 100g of $Ca(NO_3)_2$ in 1 liter of water and the substance dissolved for 2 minutes by stirring the solution.1 to 3ml of $Ca(NO_3)_2$ liquid was collected and added in 2 liters of water at graded levels and was applied 2 times using knapsack sprayer to growing biomass hydroponic maize (10).

Step 12: Management of hydroponic maize seed

Fresh water was sprayed for five (5) days on the sprouted seeds while liquid solution of N.P.K and calcium nitrates $Ca(NO_3)_2$ were sprayed from 6^{th} to 8^{th} day and this solution were withdrawn on day 8^{th} late in the evening prior to harvest (on day 9^{th}) using knapsack sprayer to spread evenly on each surface of sprouted maize, and it was kept moist, not dried or flooded as reported (11). The perforated trays were irrigated manually with hydroponics nutrient solution twice a day (07:30 and 17:30 hr) at a fixed rate of 300 ml/tray/day using knapsack sprayer for 15 minutes. Drained water was collected and measured for the total dissolved solid of calcium nitrate $Ca(NO_3)_2$ and N.P.K fertilizer solution using TDS meter against infestation as reported by (12).

Step 13: Harvesting of hydroponic maize

Table 2 Determination of herbage yield of treated and untreated hydroponic maize.

Parameters	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8	Day 9	LSD
Plant height (cm)	1.25[a]	3.52[c]	7.85[d]	14.85[a]	18.35[c]	23.45[b]	25.62[a]	30.73[c]	0.12*
Number of leaves per plant (cm)	0.92	3.86	6.45	7.45	8.65	8.71	8.92	8.96	0.12*
Biomass yield (kg)	2.92[a]	4.92[b]	3.94[c]	4.54[d]	5.62[b]	6.74[a]	6.82[c]	6.92[d]	0.12*
Leave length (cm)	1.89[a]	2.85[b]	6.24[a]	9.85[d]	10.25[a]	16.45[b]	20.82[a]	21.81[c]	0.12*
Root length (cm)	3.34[a]	5.21[c`]	7.42[a]	8.24[c]	9.34[a]	10.24[b]	13.24[a]	13.94[c]	0.12*

Key: Day 2, 3, 4 and 5 is untreated hydroponic maize using foliar application of fresh water only.
Day 6. 7 and 8 treated hydroponic maize with total dissolved solid of calcium nitrate $Ca(NO_3)_2$ and Day 9: Harvesting period of treated and untreated hydroponic maize.

Step 14: Biomass Production: Analysis of biomass production was taken for each tray throughout the experiment for the period of 90days experiment.

Impact of Environment on Growing Hydroponic Maize Fodder

The following are Impact of Environment on Growing Hydroponic Maize Fodder; Light Intensity, Temperature and Air Humidity

Challenges of growing hydroponic maize fodder

The following are challenges of growing hydroponic maize fodder

Prevalence of Mold, Management, Irrigation/ Water, Disease and Pest Managemen**t**

CONCLUSION AND APPLICATION

Hydroponic reduce the cost of feed production to our local farmers in terms of use of pesticides, insecticides, herbicides and minimize water wastage since it is applied directly to the root and is often recycled, but the water should be replaced after every 3 days to reduce microbial contamination. Therefore:

1. The irrigated water used for growing hydroponic maize should be replaced after every 3 days to reduce microbial contamination in maize.
2. Seeds should be soaked in fresh water for different periods; 4h, 8h, 12-16h and 24h depending on the hardness of the seed coat for proper growth and development of hydroponic maize.

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