EFFECT OF ORGANIC MANURE ON PRODUCTION PERFORMANCE AND NUTRITIONAL COMPOSITION OF MAIZE (*ZEA MAYS*) FODDER IN COASTAL SOIL

A THESIS

BY

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DEDICATED

TO

MY

BELOVED PARENTS

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Abstract

Maximizing Maize fodder production economically using cow dung and buffalo manure is important instead of using manure as rural fuel in coastal areas of Bangladesh. Optimization of cow dung and buffalo manure Nitrogen with fertilizer for the production of Maize fodder and dissemination of knowledge to the farmers should consider judiciously. The study was conducted to determine the effect of organic manure on production performance and nutritional composition of maize (*Zea mays*) fodder in coastal soil. The experiment was conducted with five treatments e.g. T_0 = Control (no fertilizer and manure); T_1= application of cow dung 100%(7.142 kg cow dung) ; T_2 = Application buffalo manure100%(10.714 buffalo manure); T_3 = Recommended NPK (Urea : 65.217 g, TSP: 17.78g, MOP : 32.27g); T_4 =50% NPK + 50 % Cow dung (Cow dung : 3.571 kg, Urea : 32.60g, TSP:8.89g, MOP :16.135g); T_5 = 50% NPK + 50 % buffalo manure (buffalo manure : 5.357 kg, Urea : 32.60g, TSP:8.89g, MOP :16.135g); having 3 replication for each treatment. The effects of NPK, cow dung and buffalo manure were significant ($p<0.05$) for plant height. The forage was harvested at 2 cutting periods (60 and 90 days) highly significant varied plant height and leaf width ($p<0.05$) were found at the second cutting period, they were not significant influenced at the first cutting plant height and leaf width ($p<0.05$) were found at the second cutting period, highest biomass was found 101.66 tha^{-1} of 100% cow dung at the second cutting period. The application of manures and fertilizer and cutting intervals had a significant effect ($p<0.02$) on biomass of maize forage cultivar. The treatment had no significant ($p>0.05$) effect on the percent of DM, fat, and CP, ash, moisture and CF. Highest DM% was found 15.62% (90DAP) Highest CP% was found 6.53% of cow dung 100% for 60 DAP. Highest CF% was found in the 10.70% and which was significantly ($p<0.05$) differed in Maize's stems. It may be concluded that highest biomass was found in the interaction effect of 100% cow dung at 90 days after planting while highest CP content was found in the interaction of 100% cow dung at 60 days after planting since CP content of forage was reduced with the advancing of age.

Keywords: Maize, cow dung, buffalo manure, NPK

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FAO	The Food and Agriculture Organization
IVOMID	In-vitro organic matter digestibility
CP	Crude Protein
CF	Crude Fiber
ME	Metabolizable Energy
DM	Dry Matter
NDF	Neutral Detergent Fiber
ADF	Acid Detergent Fiber
DAP	Days After Planting
%	Percentage

CHAPTER I

INTRODUCTION

Bangladesh is primarily an agricultural country and is closely related to livestock. Livestock is a major component of agriculture in Bangladesh, and the present livestock population is estimated to be 26.2 million cattle and buffaloes, 30.52 million goats and sheep (BBS 2021). Much of the world's agricultural land is degrading rapidly, and losing its productivity due to soil erosion and nutrient mining associated with continuous cropping without nutrient inputs and soil conservation. An estimated 24% of the world's land area has been degrading over the past 25 years, directly affecting the livelihoods of 1.5 billion people (Bai et al., 2008). About 59.8% of the total cultivable land is used for rice production and only 0.05% for forage production; the remainder of the land is used for other crops (BBS 2021). As farmers are interested in producing food grains for human consumption, the country is faced with an acute shortage of fodder for livestock. The scarcity of green fodder is one of the major constraints of dairy farming in Bangladesh. There is no well-defined pasture area in our country. Ruminants of our country mostly depend on crop residues, agro-industrial by-products, naturally grown leaves from trees and native grasses from roadside verges, aquatic plants, and fallows (Tabassum *et al*., 2008; Khan *et al*., 2009; Roy *et al.,* 2012; Chawdhury *et al.,* 2016). These areas are used as pasture for all kinds of ruminants and are not maintained to improve the yield for animal feed. The productivity of these pastures is low (Tabassum *et al.,* 2008) and is influenced by season and climate.

Forages continue to represent the single most important feed resource for livestock in developing countries. Selecting forage species for cultivation must take into consideration the yield, digestibility and nutrient composition (Ansah *et al.,* 2010).Maize, or corn (*Zea mays*), is widely used as an excellent livestock feed as grain, green fodder, or silage (Haque 2003), and recently has been used for human consumption. Maize is a multipurpose crop, provides food for human beings, feed for animals and poultry and fodder for livestock. It has high nutritional value as it contains about 72% starch, 10% protein, 4.8% oil, 8.5% fibre, 3% sugar and 1.7% ash (Chaudhary, 1993). It is a rich source of raw material for industry where it is being extensively used for the preparation of by products like corn starch, corn oil, dextrose, corn syrup, corn flakes, cosmetics, wax, alcohol and tanning material for leather industry. Maize is considered an ideal forage crop because it grows quickly, produces high yields, is palatable, is rich in nutrients, and helps to increase body weight and milk quality in cattle

(Sattar et al. 1994). As fodder for livestock, maize is excellent, highly nutritive, and sustainable, in green or dry condition, and is very responsive to nitrogen fertilization (Hukkeri et al., 1977).

Organic sources like farm yard manure (FYM), poultry manure (PM), green manuring and compost etc not supply the organic matters but also increase the fertility status of soil (Keupper and Gegner., 2004). Enrichment of organic matter in soil decrease soil temperature and mitigates salinity effect and increase moisture conservation and as result stimulates crop growth and quality (Raiesi., 2012). Manures not only supply the important nutrients but also improve physical and chemical properties of the soil (Sharpley et al., 2004). Bangladesh Livestock Research Institute (BLRI) with the collaboration of Bangladesh Agricultural Research Institute (BARI) started working in the year 1994 on forage production financed by Asian Development Bank. At present about 40 different forage crop germplasms are available in germplasm bank of BLRI . BLRI also developed improved technologies for forage production.

Very scanty information is available regarding manure application of different forage germplasms to farmers' door step. Study has been conducted to maximize Maize fodder production economically using cow dung and buffalo manure in coastal areas of Bangladesh. So, optimization of cow dung and buffalo manure Nitrogen with fertilizer for the production of Maize fodder and disseminating knowledge to the farmers should consider judiciously. The demand for organic food production is increasing because of its ability to maintain health without the risk of synthetic enzymes and hormones, or other chemical effects on food. Producing maize fodder with organic manure and feeding this fodder to animals is an effective way to produce organic meat and milk for human consumption.

There was very scanty information available on growth, biomass yield, nutrient content, chemical composition and energy content of maize fodder as affected by different doses of organic manures of different species with combination of inorganic fertilizers. Therefore, this study aimed to assess the suitability of organic manures with combination of fertilizer in maize fodder in coastal areas of Bangladesh.

Objectives

The overall objective of the study is to forage production in saline soils with combination of organic manure and chemical fertilizer and the specific objectives are:

1. To evaluate the effect of organic manure with inorganic fertilizer on growth and yield performance of maize.
2. To optimize cow dung and buffalo manure with inorganic fertilizer for growth and nutritional composition of maize.

CHAPTER II

REVIEW OF LITERATURE

2.1 Information about the Maize fodder

Maize (Zea mays) is a highly esteemed fodder, commonly grown in the winter season. The fodder is excellent, highly nutritive and sustainable either in green or dry condition and highly responsive to nitrogen fertilizer application (Hukkeri et al., 1977). Nitrogen application directly contributes to the quantity and quality of forage production. Excessive and imbalanced use of chemical fertilizers has adversely affected the soil causing a decrease in organic carbon reduction by microbial flora of the soil, and increasing use of nitrogen fertilizer is contaminating water bodies thus affecting fish fauna and causing health hazards to human beings and animals. Use of chemical fertilizers adds to the pollution. To overcome both the deficit in nutrient supply and the adverse effects of chemical fertilizer, it is suggested that the use of organic fertilizers will assist proper use of livestock waste as well as increase soil fertility and release nutrients to fodder for sustainable production in an eco-friendly, pollution-free environment. Cattle slurry is a potential source of soil nutrients for smallholder rural farmers. This slurry is a mixture of cow-dung, urine, feed spillage and cleaning water. Animal waste causes environmental pollution when applied to land without appropriate controls and management (Balsari et al., 2005) but the agronomic utilization of slurry represents the best solution for their reuse. Animal wastes or slurry can be a valuable resource as a fertilizer but can also be a potential hazard to the environment (Paik, 1999). Fertilizer and manure applications may affect N_2O emission in several ways depending especially on the type of N source (NO_3-, NH_4+ or organic N) and the applied amount and composition of C substrates in easily biodegradable or recalcitrant C compounds (Dambreville at el., 2008). Slurry N differs in its overall effects on physical, chemical and biological processes and consequently on nitrification and denitrification in uncropped soil. Demand for organic food for maintaining their health is a growing concern of the people. Through production of maize fodder with cattle slurry and feeding this fodder to animals, the human population can obtain organic meat, milk etc. There was no information available on growth, biomass yield, nutrient content, chemical composition and energy content of maize fodder as affected by different doses of cattle slurry. Therefore, this study aimed to assess the suitability of cattle slurry as a N fertilizer in maize fodder cultivation by measuring the yield and chemical quality of the fodder. Green fodder from maize (*Zea mays* L.), especially when it includes stalks, leaves, and ears, is a high-energy source for ruminant livestock. In cooler climates, maize fodder is often ensiled, however year-round maize production in the tropics may allow for continual collection of green forage, negating the need for ensiling (Brewbaker, 2003). In times of shortage (dry, hot summers and winters), grazing whole maize plants also supplies green feed to animals (Potter, 2012; Newport, 2006). A good source of fodder for small holder-owned livestock in difficult environments with limited forage is maize green forage (Methu *et al.*, 2006). In comparison to the majority of other tropical fodder crops, where the DM is frequently less than 40% digestible, maize is a higher calorie feed. Whereas maize feed in the tropics matures within three months, is only collected once, and doesn't require a lot of labor or expensive technology, grass forages in the region must be harvested virtually monthly (Brewbaker, 2003).

The popularity of baby corn as a vegetable is rising all throughout the world. Baby corn is made up of young, immature cobs of maize plants that were picked before pollination and a few days after silk emergence. Baby corn can be grown using the same hybrids as regular maize crops or using specially adapted hybrids that are smaller and produce multiple stalks. Baby corn is a commercial crop that matures quickly and only needs 55–60 days between planting and harvest. The crop remnants, which include stalks, leaves, husks, and silk, provide very good quality fresh feed that cattle find appetizing because it is picked at an early stage of growth. It can be grown year-round in tropical regions. 2013 saw an output of more than 276 000 t of baby corn in Thailand. It can be expected that the remaining 85% of the production, which only makes up 15% of the edible baby corn cob, might produce more than 1 million t of fodder (green matter). You can feed baby corn forage either fresh or ensiled. Central America is the original home of the maize plant, which later expanded to the Caribbean, Southern, and Northern America. Now, 58°N in Canada and Russia and 40°S in Chile and Argentina, and from sea level to an altitude of 3800 m in the Andean mountains, are the ranges where it grows, thanks to genetic selection and hybridization (Ecoport, 2010). In the 18th and 19th centuries, maize was a useful backyard plant in Europe. In France, maize was widely planted to supply "fourragettes," or green forage, beyond the region where grain could be grown (South Brittany, former Maine, Paris Basin, Lorraine). In the late summer and early fall, when other grasses were in short supply, it was employed in animal diets.

2.2 Cow dung and buffalo manure

Cow dung and buffalo manure are natural slow- release fertilizer. Nutrient in cow dung and buffalo manure fertilizer provide adequate nourishment for soil .It is high in nitrogen, both phosphorus and potassium essential elements for optimal plant growth. These nutrients help plants to establish strong roots, defend against pest and grow into vibrant and productive plants. One of the important aspects of these farming business are having an effective waste management plan which reaps the benefits and reduces the risks caused by improper disposal of cow dung and buffalo manure wastes.

An experiment was conducts by Birkhofer et al., (2008) to observe the Organic manures have more beneficial effects on soil quality than inorganic fertilizers thereby improving nutrient release and their availability to the plants.

An experiment was confirmatory with Limaet al. (2009) who stated that incorporation of organic manures improves soil physico-chemical properties that may have a direct or indirect effect on plant growth and yield attributes. The positive correlations between soil NPK status and the grain yield indicates that the soil nutrient status may affects grain yield and its components directly

An experiment was conducted by Yang *et al* (2021) to observe the combined effects of sheep manure with chemical fertilizer on maize yield and found that the yield of sheep manure combined with chemical fertilizer is much higher than that of only sheep manure and no fertilizer and also found that among 15%, 30%, and 45% sheep manure with chemical fertilizer the crop yield was observed with the combination of 15% sheep manure nitrogen with chemical fertilizer. The experiment revealed that the combined application of chemical fertilizers with sheep manure can increased the partial productivity and agronomic utilization rate of the nitrogen fertilizer and increase crop yields.

2.3 Agronomic growth parameters of maize fodder

Naik et al.(2011) conducted by the hydroponics green fodder was looking like a mat consisting of roots, seeds and plants.

Jamali et al. (2008) examined the effect of sewage sludge on the growth and production of maize, and also determined the heavy metal content in the product. They observed that a significant amount of Zn, Cu, Cd, Pb, and other trace and toxic metals were present in the sewage sludge. They treated the sewage sludge with lime before application to the maize field, which had a positive effect on heavy metals. The experiment showed that heavy metals were transmitted from the sewage sludge to the maize and reduced the quality of the maize. Heavy metal content was significantly reduced (30%) in the lime-treated maize, as compared to the untreated sewage sludge. It is possible that some heavy metals were in the biogas slurry used in the present experiment, even though the biogas slurry contained a good amount of N, P, K, and S. Additional research should be conducted to identify which heavy metals are in biogas slurry and how to eliminate them.

Chavan and Kadam,(1989) experimented that there were differences ($P<0.05$) in the nutrients content of hydroponics fodder maize during different stages of growth and maize grown in conventional practices. The CP content of the maize seed was 8.60%, which remained similar up to 2nd day (9.14%) of growth in hydroponics system. The CP content of the sprouted maize showed an increasing trend with germination time and remained highest ($P<0.05$) on 7th day (13.57%) of growth. The increase in protein content may be attributed to the loss in dry weight, particularly carbohydrates, through respiration during germination and thus longer sprouting time was responsible for the greater losses in dry weight and increasing trend in protein content. Up to 3rd day of growth of the hydroponics fodder maize, CP content was lower than CP content (10.67%) of fodder maize harvested at about 60 days under conventional practices; but from 4th day onwards, values of the former remained higher ($P<0.05$) than the later.

Tolera and Sundstol (2000) reported higher N retention in sheep fed maize fodder cut at early stage than those fed maize fodder cut at late stage of maturity. Furthermore, plausible explanation of the increased N balance in animals fed EH fodder might be attributed to the fact that EH contained higher CP that might have enhanced microbial proliferation and thus ultimately increasing the post rumen amino acid supply and N retention compared to those animals fed on MH and LH.

By using five nitrogen levels : 0,15,20, 25 and 30kg n/h , an experiment was conducted by Hasan et al (2010) to evaluate the effects of nitrogen fertilizer on growth parameters of cowpea forage and observe that plant height was significantly ($p <0.01$) influenced by nitrogen fertilizer and height (96.25cm) was observed at 25kgN/ha.

Motalib (2003) reported that the optimum time for harvesting green maize plants as fodder is when 50% of the plants are in the flowering state and contain 60%-70% moisture. At this stage maize plants contain sufficient nutrients and are sufficiently succulent. Finally, maize fodder from each plot was harvested 56 days after sowing, when 50% of the plants were in the flowering state. Harvesting was performed manually and samples were kept for further analysis. Immediately after harvesting, biomass yield of the maize fodder from each plot was recorded using a weighing balance.

2.4 Biomass

Reddy et al. (1987) reported the positive effect of nitrogen fertilizer on maize plant height; plant height increased significantly in response to applying as much as 80 kg of nitrogen ha-1. Other factors might also affect fodder plant height, such as the genetic makeup of fodder, soil fertility, climatic conditions, quantity of daylight, light intensity, and season. Among these, genetic factors and soil fertility are more important.

Rahman et al.(2008) reported that Genetic factors and soil fertility are more important. Nitrogen fertilizer, either organic or inorganic, always affects vegetative growth of the fodder plant. Biomass yield in fodder depends on the number of leaves, leaf area, fodder height, stem circumference etc.

Reiad et al. (1997) reported that nitrogen affects vegetative growth and increases stem circumference. Maize stalk diameter was reported to be strongly influenced by environmental conditions (Duncan 1975).

Rahman et al. (2008) observed that approximately 67 kg of slurry N ha-1 is an optimum level for maize fodder production. The number of leaves per plant is controlled primarily by genetic factors and is also affected by some other environmental factors, such as seed rate and temperature.

Ibrahim et al. (2006) reported that the number of leaves per plant in maize and cowpea is also affected significantly by different seed ratios and crop combinations. They observed that the average number of leaves per maize plant was 12.18 when maize was sown alone, but 11.82 when grown in combination with cowpea.

Halima (1999) also obtained increased plant height, stem weight and leaf weight at the highest nitrogen doses (100 kg N/ha) compared to the control (0 kg N/ha) and the trend was linear. Fodder height in the present experiment was 9.53% higher at 56 days compared to that reported by Hossain (2001).

Dauden and Quilez (2004) conducted an experiment on maize yield with different levels of pig slurry and observed no significant differences in plant number, plant height and biomass yield among different treatments, but a decreasing trend of grain yield was observed at the higher rate of slurry N. The nitrogen fertilizer value of slurry is thus considered similar to that of mineral fertilizer, because higher N level reduced the yield.

2.5 Nutritional parameters

Maize forage nutritional parameters

Main analysis	Unit	Avg.	S.D.	Min.	Max.	Nb.
Dry matter	% as fed	23.3	6.4	12.6	47.6	51
Crude protein	% DM	7.9	2.1	3.0	12.8	98
Crude fibre	% DM	28.7	3.9	19.1	36.6	82
NDF	% DM	63.2	7.1	54.7	81.5	32
ADF	% DM	31.3	5.5	23.3	45.7	32
Lignin	% DM	4.3	0.8	2.9	6.0	23
Ether extract	% DM	1.9	0.6	0.7	3.1	55
Ash	% DM	7.0	2.1	2.5	11.8	97

Avg. = Average; SD= Standard deviation; Min. = Minimum; Max. = Maximum; Nb= Number of samples; DM= Dry matter *.Axtmayeret al.(1938).*

2.6 Crude protein

Eltelib et al. (2006) studied on the effect of nitrogen and phosphorus application on growth , forage effect on the growth of plant and protein also influenced by nitrogen.

Beckwith et al. (2002) reported that crude protein content in cut grass increased as the level of cattle slurry increased.

Sarker (2000) also observed an increase in CP in response to increasing the level of nitrogen fertilizer of Safdar (1997) and Tariq (1998) reported that in fodder maize, by increasing nitrogen levels; crude protein, crude fiber and ash contents were increased.

Ahmad (1999) also reported that crude protein percentage increased with the increase of nitrogen fertilizer.

Safdar (1997) reported that green fodder yield; protein, fiber and total ash contents were increased with nitrogen rates in maize.

Singh et al. (1996), an experiment conducted with 2 varieties of oat which is in contrast to the results of the present experiment. Increasing the level of slurry nitrogen presumably increased the availability of soil nitrogen, and that of other macro- and micronutrients, which might have enhanced meristematic growth and resulted in higher fodder yield. Nitrogen is a vitally important plant nutrient involved in protein and enzyme synthesis. All metabolic plant processes are controlled by enzymes. Moreover, nitrogen is an integral component of chlorophyll, the primary molecule that absorbs the light energy needed for photosynthesis. The observed increase in green forage yield in response to slurry nitrogen might have been due to its positive effect on cell elongation, cell division, formation of nucleotide and coenzyme in meristematic activity, and increasing photosynthetic surface, resulting in more production and accumulation of photosynthetic compounds. High P content of the slurry might also have positively contributed to the biomass yield of maize. Phosphate compounds act as an energy currency in plants, and play an important role in photosynthesis and the metabolism of carbohydrates; they are also stored for subsequent growth and reproductive processes.

Devevatti et al (2019) evaluated the effect of nitrogen fertilizer on the nutrient composition of Marandu grass at field salinity level and found the crude protein content increased rather than fiber content by adequate application of nitrogen fertilizer in the grass.

Ullah et al.(2010) conducted and experiment on effect of nitrogen fertilizer and harvesting intervals on the forage yield and nutritional value of Elephant grass and found that crude protein content decreased with longer harvesting intervals.

2.7 Crude Fiber

Eltelib et al.(2006) studied on the effect of nitrogen and phosphorus application on growth, forage yield and quality of fodder and found that nitrogen and phosphorus had no effect on crude fiber.

Azim et al. (1989) found that crude fiber (CF) content of various fractions of the plant ranged between 19.12 to 35.60% with maximum values in the bottom portion of the stem. Matured plants contained more CF.

Chunget al., (1989) found the increase in CF content during sprouting of maize might be due to the synthesis of structural carbohydrates such as cellulose and hemicelluloses.

Reported by Naik et al. (2013) who observed the DM content of the hydroponically sprouted maize grains as 18.30% and the CP, EE, CF, NFE, TA and AIA content (on % DM basis) as 13.30, 3.27, 6.37, 75.32, 1.75 and 0.57,respectively.

Sarkar e tal. (2004) experimented the effect of different doses of nitrogen fertilizer on yields and chemical composition of Zamboo grass and found that CP, CF, and EE yields increased with increasing fertilizer dose in the cut, while in the second cut all other adjacent components except CF decreased.

2.8 Dry mater (DM), Ether extract (EE) and Ash content

In accordance with Naik and Jemimah et al. (2018) who reported higher TA and lower NFE in conventional maize fodder harvested at about 60 days. Higher DM, CF, NFE and TDN in hydroponic maize fodder may be due to lower nutrient losses during growth process and higher proportion of root biomass compared to land grown maize fodders. The higher EE content of the land grown maize fodder may be due to the increase in the structural lipids and production of chlorophyll associated with the plant growth and the higher TA may be due to uptake of minerals from the soil by the extending roots during growth and presence of considerable portion of soil in the harvested fodder sample. The increase in dry crude protein content is due to loss in dry matter content particularly carbohydrate. Moreover, nutrient absorption also facilitates the metabolism of nitrogenous compounds which lead to increase the crude protein content. Thus, hydroponic maize fodder is superior to land grown maize fodder of similar growth period and area of production in terms of fodder yield (both dry and fresh matter basis) and nutrient composition.

CHAPTER III

MATERIALS AND METHODS

3.1 Site of the experiment

The experiment was conducted at East Shalabunia, Bongobondhupara, Mongla Upazila, Bagerhat District.

3.2 Design of Experiment

The design of the experiment was factorial RCBD with cuttings interval (C1=60 Days and C_2=90 days) and fertilizer treatments (T_0 = Control as no fertilizer and manure; T_1= 100% Cow dung 100%; T_2 = 100% Buffalo manure; T_3 = Recommended NPK (Urea : 65.217 g, TSP: 17.78g, MOP : 32.27g); T_4 =50% NPK + 50 % Cow dung ; T_5 = 50% NPK + 50 % Buffalo manure) having three replications.

3.3Adjustment of NPK fertilizer

The recommended value of NPK (0-75 of N kg/ha; 0-20 of p kg/ ha; 0-40 of K kg/ha) respective (Fertilizer Recommendation Guide- 2018) . When the NPK was applied for maize fodder production the amount of cow dung and buffalo manure also adjusted with.

Treatment	Amount of fertilizer and manure
T_0	No fertilizer and manure
T_1	7.142 kg cow dung
T_2	10.714 kg buffalo dung
T_3	Urea: 65.217g, TSP: 17.78 g and MOP: 16.135 g
T_4	Cow dung: 3.751 kg, Urea: 32.60 g TSP:8.89 g, and MOP:16.135 g
T_5	Buffalo dung: 5.357 kg, Urea: 32.60 g, TSP: 8.89 g and MOP: 16.135 g

3.4 Layout of the experiment

Treatment	Harvest frequency	R_1	R_2	R_3
T_0	C_1	$T_0C_1R_1$	$T_0C_1R_2$	$T_0C_1R_3$
T_1	C_2	$T_1C_1R_1$	$T_1C_1R_2$	$T_1C_1R_3$
T_2		$T_2C_1R_1$	$T_2C_1R_2$	$T_2C_1R_3$
T_3		$T_3C_1R_1$	$T_3C_1R_2$	$T_3C_1R_3$
T_4		$T_4C_1R_1$	$T_4C_1R_2$	$T_4C_1R_3$
T_5		$T_5C_1R_1$	$T_5C_1R_2$	$T_5C_1R_3$
		$T_0C_2R_1$	$T_0C_2R_2$	$T_0C_2R_3$
		$T_1C_2R_1$	$T_1C_2R_2$	$T_1C_2R_3$
		$T_2C_2R_1$	$T2C_2R_2$	$T_2C_2R_3$
		$T_3C_2R_1$	$T_3C_2R_2$	$T_3C_2R_3$
		$T_4C_2R_1$	$T_4C_2R_2$	$T_4C_2R_3$
		$T_5C_2R_1$	$T_5C_2R_2$	$T_5C_2R_3$

T_0 = control (no fertilizer and manure); T_1= application of cow dung 100%(7.142 kg cow dung) ; T_2 = application buffalo manure100%(10.714 buffalo manure); T_3 = recommended NPK (urea : 65.217 g, TSP: 17.78g, MOP : 32.27g); T_4 =50% NPK + 50 % Cow dung (Cow dung : 3.571 kg, Urea : 32.60g, TSP:8.89g, MOP :16.135g); T_5 = 50% NPK + 50 % buffalo manure (buffalo manure : 5.357 kg, Urea : 32.60g, TSP:8.89g, MOP :16.135g)

3.5 Preparation of plot

Thirty six (36) plots having the same dimension of 2m×3m= 6m^2 spaces for each plot was arranged for this experiment.

3.6 Cow dung and buffalo manure analysis

Cow dung and buffalo manure were analyzed using Kjeldahl Distillation unit, UK; Spectrophotometer TG, china and Flame photometer JENWAY, UK for content of Nitrogen, P and K, respectively. After reviewing analysis, the cow dung consists of 0.42% N, 0.09175 % P, 1.027%K and Buffalo manure consists of 0.28%N, 0.53% and 0.48% K.

3.7 Fertilizer management

Half of measured manures and fertilizer was applied after during land preparation. Rest of half organic manure and fertilizer was applied after 10 days of 1st application. After 60 days and 90 days of planting sample was collected for analysis.

Plantation

Maize seeds were sowen on 7th February 2023 by line method keeping 2cm under the soil with maintaining 30 cm X 30 cm distance between row to row and plant to plant spacing.

Irrigation and Drainage

Irrigation and drainage were done in each plot when necessary.

3.8Collection of Data

Agronomical data such as plant height, leaf number, leaf length, leaf width, tiller number, biomass, stem diameter & nutritional data e.g. percentage of dry matter, crude protein ash and ether extract were collected after harvesting of the forage cultivars at two intervals (60 and 90 Days.

Agronomical data

Plant Height

Five plants were selected randomly for determination of plant height. The height of each plant was measured from the ground to the top of the upper most of leaf of the plant and mean value of plant height was recorded.

Leaf Length and leaf width

The leaf length was measured from the tip of the entire leaf down to the base of the leaf blade. After measuring each leaf length their mean value was recorded.

Biomass yield of fodder

Fresh yield was recorded immediately after cutting the fodder by weighing it with a balance, and yield was expressed in tha-1. Weighing the mass was used to calculate the biomass yield of maize,

Sample Preparation

After harvesting the grass, the whole grass sample was cut into pieces of less than one cm size with a knife. After taking the sample for dry matter and ash test, rest of the sample was dried at 105^0C for overnight, grinded with blender machine and kept separately in an airtight sample packet.

3.9 Proximate analysis

3.9.1 Crude protein analysis

Test procedures

Digestion

Digestion was completed by using DK 8 Heating DIGESTER VELP SCIENTIFICA. 1g of sample was weighted with an accuracy of± 0.1mg. for each sample 2 catalyst and 12 ml H2S04 were added and then placed into digestion block. The temperature of the digestion block maintained at 420°c and sample was heated for 60 minutes until the fumes stopped. Then the sample was taken to cool at 50°-60°.

Distillation

Distillation process was conducted by using UDK 129 Distillation unit VELP SCIENTIFICA. After cooling the sample, it was mixed with 50 ml distilled water .50ml NaOH was added with the solution. The digestion flask was then given into the distillation chamber. 30ml Boric acid solution was taken in a conical flask and 3 drops of indicator were added into it. The water flow was previously adjusted the distillation process was done until color of indicator mixture solution did not into green.

Titration

The sample of the flask was then taken for titration. Then 0.1% H_2SO_4 was taken in burette pipe and added drop wise. The procedure was continued until the color of the solution of the conical flask turn from green to blue. When the solution then recorded .

Calculation

Calculation

$$= \frac{(\text{ml H2SO4 sample} - \text{ml H2SO4 blank}) \times \text{conc.H2SO4 } 14.007 \times 100}{\text{Wight of sample} \times 1000}$$

3.9.2 Crude fibre analysis

Test procedure

Crude fibre analysis was conducted by using VELP SCIENTIFICA FIWE Raw fiber Extractor. 1 g sample was taken in crucibles were fixed with the channels. 150 ml 1.25% H_2SO_4 was taken in the flask of the analyzer adding 3-5 drops n- octanol asanti foam agent. The switch of the fibre analyzer was turned on. Boiled exactly for 30 minutes . After 30 minutes, filter the remaining agent. Washing should be done three times with 30ml. (crucible filled to the top) of hot deionized water, connecting each time to compressed air for stirring the content of crucible. After draining last wash, 150 ml 1.25% KOH and 3-5 drops of anti-foam agent were added. Again after boiling for 30 minutes then washing 3 times, a last washing was done with cold deionized water to cool the crucible and then wash three times the crucible content with 25ml of acetone and stirring by compressed air. The crucible content with 25 ml of acetone was washed. After that crucibles were dried at 105° C for one hour in oven and then cooled down in a desiccator to take the dry weight (F_1). The crucibles were placed into a muffle and heated up to 550° C for three hours to reweight after cooling in a desiccator (F_2).

Calculation:

Crude fiber (%) = $\frac{F1-F2}{F0} \times 100$

Where,

F_0 = Weight of sample in gram

F_1= Weight of oven dried sample in gram

F_2= Weight of ash containing crucible in gram

3.9.3 Ether Extract

Test method procedure:

Sample: 3 g (F_1) of grounded and homogenized material was weighed in an extraction thimble with 1 mg proximation. Total weight- thimble weight = wet sample weight.

Chemicals: petroleum ether 40-60° C, with an evaporation of residue not higher than 10mg/l.

Sample drying: dried the thimble one hour in a 125° C oven.

Immersion: sample containing thimble or the glass crucible containing dry hydrolysed sample were introduced into the extraction equipment. After weighing extract collecting vessel (F2), 40ml of petroleum ether was added. Thimble with sample, assembled with thimble connector to extraction unit. After closing the extraction unit, the cooling water flow started and the heating. When the solvent started boiling, the thimble or glass crucibles were placed into "Immersion" position for 30 minutes.

Washing: after 30 minutes extracted, thimble or glass crucible were placed into "Washing" position for 60 minutes.

Recovery: after washing, the stopcock located under the water, was closed and cooled in condenser and evaporated completely the solvent from the extraction vessel.

Weighing : The extract containing cups were dried in oven at 125° C for 30 minutes and weighed (F3) it after cooling a desiccator.

Calculation:

Ether Extract (%) = $\frac{W3-W2}{W1} \times 100$

Where,

W_1 = Weight of sample in gram

W_2 = Weight of empty vessel in gram

W_3 = Weight of vessel and ether extract in gram

3.9.4 Dry matter

Test procedure

Envelopes were weighted (W_1) and weight was recorded to 0.001 g. After harvesting, fresh shoot weight (W_2) of forage was taken and the envelope was filled with sample and dried in oven for 24 hours at 105°C. Thereafter the dried sample containing envelope (W3) is weighted.

Calculation:

$$\text{Dry Matter (\%)} = \frac{W3-W1}{W2} \times 100$$

Where,

W_1 = Weight of envelope in gram

W_2 = Weight of fresh sample in gram

W_3 = Weight of envelope and dried sample in gram

3.9.5 Ash Analysis

Test Procedure

Crucibles were placed in muffle furnace, allowing 30 minutes to reach 600°C. Weight of crucible was recorded to 0.0001g (W_1). About 3g sample was weighted into a crucible which had been tarred. Weight of sample was recorded to 0.0001g (W_2). Ash crucibles containing samples in muffle furnace at 600°C for 6 hours after the furnace had reached the temperature. Crucibles were allowed to cool in furnace to less than 20°C and crucibles were placed in desiccator with a vented top. Crucibles were cooled in desiccator to room temperature and were weighed immediately. Weight was recorded to 0.0001g (W_3). Ash% was calculated and reported to one decimal place.

Calculation

Ash (%) = $\frac{W3-W1}{W2} \times 100$

Where,

W_1 = Weight of crucible in gram

W_2 = Weight of sample in gram

W_3 = Weight of crucible and ash in gram

3.10Statistical analysis

Data was evaluated separately by using the analysis of variance (ANOVA). Mean differences was assessed by the Duncan New Multiple Range Test. Calculated data on various parameters under study was statistically analyzed using 'SPSS' software.

CHAPTER IV

RESULTS AND DISCUSSION

4.1 Agronomic Growth parameter of maize

4.1.1 Effect of Cutting height on agronomic growth parameter

Table1 showed that highest plant height was found in T_4 (254.00 cm) and the lowest one was in T_0 (212.35 cm). The treatment had no significant ($p>0.05$) effect on the plant height. Ibrahim *et al.,* 2006 reported that mean plant height of maize showed alone was higher (227.8 cm) than all other seed combinations which is matched with the present findings. Highest stem length was found in T_4 (26.65 cm) and lowest was in T_3 (18.91 cm). Zada et al. (2000), who reported that plant height increases with the increase in farmyard manure and nitrogen doses. Similarly, Oad et al. (2004) also reported that maximum plant height 150.82 cm of maize fodder was recorded with application of 120 kg nitrogen + 3000 kg FYM tha-1 and Chellamuthu et al. (2000) that the combine application of bio fertilizer together with 75% of recommended NP increase plant height compare with 100% NP alone. The treatments had significant ($p<0.05$) effect on the stem length. Highest leaf width (3.61cm) was found in T_2 and lowest value was found in T_0(3.08cm) which is not significantly ($p>0.05$) affected. Highest leaf length (42.34 cm) was found in T_2, and the lowest leaf length was found in T_0 (37.21cm) which is significantly ($p<0.05$) affected. Highest biomass (83.66 tha-1) was found in T_1 and lowest value (27.18 tha-1) was found in T_0.The treatments have a significant effect ($p<0.05$) on biomass production. Naterchera and Salagae (2002) who reported that fodder yield per plant of maize fodder increased with the application of cattle and chicken manure. Ayub et al. (2002), who reported that NP produced significantly higher fodder yield of maize than control. Similarly Devi(2002) also reported that fodder maize variety "African Tall" produced significantly higher green fodder yield at higher dose of nitrogen while bio fertilizers produced lower yield. Green fodder yield increased significantly up to 120 kg N tha-1. In contrast Reiad et al. (1992) and Lakoo et al. (2004) reported that organic manures and inorganic fertilizer increase the maize fodder yield. Dauden and Quilez (2004) conducted an experiment on maize yield with different levels of pig slurry and observed no significant differences in plant number, plant height and biomass yield among different treatments, but a decreasing trend of grain yield was observed at the higher rate of slurry N. The nitrogen fertilizer value of slurry is thus considered similar to that of mineral fertilizer, because higher N level reduced the yield.

Table 1: Effects of treatments on agronomic parameters

Treatment	Plant height (cm)	Steam length (cm)	Leaf width (cm)	Leaf length(cm)	Biomass (tha^{-1})
T_0	212.35	19.87	3.08	37.22	27.18^{b}
T_1	240.90	20.76	3.42	41.89	83.66^{a}
T_2	232.70	19.68	3.60	42.34	47.90^{b}
T_3	235.75	18.91	3.30	40.83	80.27^{a}
T_4	254.00	26.65	3.61	39.16	64.64^{a}
T_5	238.20	20.40	3.49	41.46	62.54^{b}
SEM	9.55	1.28	00.17	1.64	10.30
P	0.14	0.012	0.28	0.29	0.02

T_0 (Control): No fertilizer and manure, T_1: Application of cow dung 100%, T_2: Application of buffalo manure 100%, T_3: Recommended NPK (Urea: 65.217 g, TSP: 17.78g, MOP: 32.27g), T_4: 50% NPK + 50% Cow dung (Cow dung: 3.571 kg, Urea: 32.60g, TSP: 8.89g, MOP: 16.135g), T_5: 50% NPK + 50% Buffalo manure (Buffalo manure: 5.357 kg, Urea: 32.60g, TSP: 8.89g, MOP: 16.135g) NS=non-significant, ***=p<0.001, **=p<0.01, *=p<0.05

Date on table2 illustrates the effect of cutting interval on agronomic parameters of maize fodder. It is shown in Table 2 that highest plant height was found in C_2 (245.91cm) and lowest one was in C_1 (225.38 cm). The cutting interval has a significant ($p<0.05$) effect on the plant height. Highest stem length was found in C_2 (26.36 cm) and the lowest was in C_1 (15.72 cm). The cutting interval has a significant ($p<0.01$) effect on the stem length. Highest leaf width (4.72cm) was found in C_2 and lowest value found in C_1 (2.11cm) is significantly ($p<0.01$) affected. Highest leaf length (55.36 cm) was found in C_2 and the lowest leaf length was found in C_1 (25.60 cm). The cutting interval has a significant ($p<0.01$) effect on the leaf length. Highest biomass (61.52 tha^{-1}) was found in C_1 and the lowest value (60.54tha^{-1}) was found in C_2. The cutting interval has not significant ($p>0.05$) effect on the biomass. The data suggests that cutting interval C_2 generally shows higher values in most parameters except for biomass, which was slightly higher for cutting interval C_1.

Table 2: Effects of cutting interval on agronomic parameters

Treatment	Plant height (cm)	Stem length (cm)	Leaf width (cm)	Leaf length (cm)	Biomass (tha^{-1})
C_1	225.38^{B}	15.72^{B}	2.11^{B}	25.60^{B}	61.52^{A}
C_2	245.92^{A}	26.36^{A}	4.72^{A}	55.36^{A}	60.54^{B}
SEM	5.52	0.74	0.09	0.94	5.95
P	0.05	0.01	0.01	0.01	0.91

*DAT INDICATES DAY AFTER TREATMENTS; C_1 = 60 DAP; C_2 = 90 DAP NS=NON-SIGNIFICANT, ***=P<0.001, **=P<0.01, *=P<0.05;*

The Table 3 presents the interaction effects of various organic manure applications and cutting intervals on the production performance of maize (*Zea mays*) fodder. Table 3 showed that highest plant height was found in the combination of T_3C_2 (263.50 cm) and the lowest one was found in the interaction of T_0C_1 (193.00 cm). Highest stem length was found in the combination of T_4C_2 (36.10 cm) and the lowest was in the interaction effect of T_0C_1 (13.95 cm). The application of manures and fertilizer and cutting intervals had a significant effect ($p<0.03$) on stem length of maize forage cultivar. Highest leaf width was found in T_4C_2 (4.91 cm) and the lowest value was found in the interaction of T_0C_1 (1.74 cm). Highest leaf length was found in the interaction of T_2C_2 (59.13 cm), and the lowest leaf length was found in the interaction of T_0C_1 (22.33 cm). Highest biomass was found in the interaction of T_1C_2 (101.66 tha^{-1}) while the lowest value was found in the interaction of T_0C_1 (12.61tha^{-1}).The application of manures and fertilizer and cutting intervals had a significant effect ($p<0.02$) on biomass of maize forage cultivar.

Table 3: The effects of various organic manure application on the production performance of maize

Interaction		**Plant height (cm)**	**Stem length (cm)**	**Leaf width (cm)**	**Leaf length (cm)**	**Biomass (t ha^{-1})**
T_0	C_1	193.00	13.95^{B}	1.74	22.33	12.61^{B}
	C_2	231.70	25.80^{A}	4.41	52.10	41.75^{A}
T_1	C_1	239.00	15.52^{B}	2.18	28.07	65.67^{B}
	C_2	242.80	26.00^{A}	4.66	55.70	101.66^{A}
T_2	C_1	228.50	17.47^{B}	2.28	25.56	66.00^{A}
	C_2	236.90	21.90^{A}	4.92	59.13	29.80^{B}
T_3	C_1	208.00	14.02^{B}	2.05	23.17	72.37^{B}
	C_2	263.50	23.80^{A}	4.60	58.50	88.16^{A}
T_4	C1	250.80	17.20^{B}	2.31	27.77	99.61^{A}
	C2	257.20	36.10^{A}	4.91	50.55	29.66^{B}
T_5	C1	233.00	16.20^{B}	2.14	26.75	52.87^{B}
	C2	243.40	24.60^{A}	4.83	56.18	72.21^{A}
SEM		13.51	1.81	0.23	2.32	14.57
P		0.35	0.03	0.99	0.18	0.02

DAT indicates day after treatments; C_1 = 60 DAP; C_2 = 90 DAP T0 (Control): No fertilizer and manure, T_0 (Control): No fertilizer and manure, T_1: Application of cow dung 100%, T_2: Application of buffalo manure 100%, T_3: Recommended NPK (Urea: 65.217 g, TSP: 17.78g, MOP: 32.27g), T_4: 50% NPK + 50% Cow dung (Cow dung: 3.571 kg, Urea: 32.60g, TSP: 8.89g, MOP: 16.135g), T_5: 50% NPK + 50% Buffalo manure (Buffalo manure: 5.357 kg, Urea: 32.60g, TSP: 8.89g, MOP: 16.135g) NS=non-significant, ***=p<0.001, **=p<0.01, *=p<0.05

4.2 Nutritional composition of maize

It is shown in Table 4 that highest DM% was found in T_0 (20.26%), while the lowest was found inT_4 (17.16%) leaf of maize fodder. CP% (Crude Protein Percentage) reflects the protein content in the leafs.

Table 4: Treatment on nutritional composition of maize's leaf

Treatment	DM%	CP%	Ash%	Moisture%	CF%	Fat%
T_0	20.26	3.762^{D}	6.49^{C}	80.37	14.43^{C}	1.30^{B}
T_1	18.73	7.96^{A}	7.58^{AB}	84.09	18.95^{A}	3.16^{AB}
T_2	17.29	5.08^{C}	7.87^{A}	82.13	18.11^{A}	2.1^{AB}
T_3	18.80	6.65^{B}	6.70^{BC}	81.11	15.47^{B}	2.53^{AB}
T_4	17.16	6.53^{B}	7.29^{ABC}	82.30	18.23^{A}	3.49^{A}
T_5	19.49	5.22^{C}	7.18^{ABC}	80.48	18.17^{A}	3.02^{AB}
SEM	1.596	0.27	0.22	1.23	0.33	0.39
p	0.71	0.00	0.05	0.33	0.00	0.01
cv	17.14	9.10	6.00	3.02	4.30	30.61

T_0 (Control): No fertilizer and manure, T_1: Application of cow dung 100%, T_2: Application of buffalo manure 100%, T_3: Recommended NPK (Urea: 65.217 g, TSP: 17.78g, MOP: 32.27g), T_4: 50% NPK + 50% Cow dung (Cow dung: 3.571 kg, Urea: 32.60g, TSP: 8.89g, MOP: 16.135g), T_5: 50% NPK + 50% Buffalo manure (Buffalo manure: 5.357 kg, Urea: 32.60g, TSP: 8.89g, MOP: 16.135g) *NS=non-significant, ***=$p<0.001$, **=$p<0.01$, *=$p<0.05$*

The highest CP% was found in T1 (7.96%), while the lowest was found in T2 (5.07%) which was significantly ($p<0.01$) differed. Highest ash content was found in T0 (6.49%), while the lowest one was found in T3 (6.7%)) which was significantly ($p<0.05$) differed. Highest crude fiber content was found in T0 (18.95%), while the lowest was in T0 (14.43%) which was significantly ($p<0.01$) differed.

Safdar (1997) and Tariq (1998) reported that, with the increase of nitrogen levels in maize fodder, crude protein, crude fiber and ash contents were also increased. Similarly, Ahmad (1999) also reported that crude protein percentage increased with the increase of nitrogen fertilizer. Safdar (1997) who reported that green fodder yield; crude protein, crude fiber and total ash contents were increased with the increase of various nitrogen rates in maize. Beckwith et al. (2002) found increasing level of cattle slurry on cut grass increases the crude protein content of forage. All findings supports the present findings.

It reveals in Table 5 that highest DM% was found in C2 (20.97%) and the lowest was found C1 (16.27%) which was significantly ($p<0.04$) differed. The CP% was highest in C1 (7.22%) while the lowest was found in C2 (4.50%) which was significantly ($p<0.01$) differed. The highest ash% was found in C1 (7.53%) and the lowest ash% was found in C2 (6.83%) which was also significantly ($p<0.02$) differed. Highest CF% was found in C2 (18.137%), while the lowest was in C1 (16.32%) which was significantly ($p<0.01$) differed. In case of fat%, highest fat content was found in C1 (2.61%), while the lowest was found in C2 (2.59%).

Table 5: Cutting interval on nutritional composition of maize's leafs

Treatment	DM%	CP%	Ash%	Moisture%	CF%	Fat%
C_1	16.27^{A}	7.22^{A}	7.53^{A}	84.38^{A}	16.32^{B}	2.62
C_2	20.97^{B}	4.51^{B}	6.83^{B}	79.11^{B}	18.14^{A}	2.59
SEM	0.92	0.15	0.12	0.71	0.19	0.23
p	0.04	0.00	0.02	0.003	0.00	0.97

DAT indicates day after treatments; C_1 = 60 DAP; C_2 = 90 DAP *NS=non-significant,* ***=$p<0.001$, **=$p<0.01$, *=$p<0.05$; *DM= Dry matter, CP= Crude protein, CF= crude fiber.*

It is shown in Table 6 that highest DM% were found in the interaction effect of T_5C_2(23.51%) and the lowest were found in the interaction effect of T_4C_1 (14.07%). In the case of crude protein (CP) the highest CP% was found in the interaction effect of T_1C_1 (9.54%) and the lowest was found in the interaction effect of T_5C_2 (2.79%). Highest ash% was found in the combination of T_2C_1 (8.07%) and the lowest was found in the interaction effect of T_0C_2 (6.29%). Highest moisture% was found in the interaction effect of T_1C_1 (85.72%) and the lowest was found in the interaction effect of T_5C_2 (76.49%). Highest CF% was found in the interaction effect of T_1C_2 (19.56%) and the lowest was found in the interaction effect of T_0C_1 (13.76%). The treatment had no significant ($p>0.05$) effect on the percent of DM, fat, and CP, ash, moisture and CF.

Table 6: Effect of cutting height and cutting interval on nutritional composition of maize's leaves

Treatments		DM%	CP%	Ash%	Moisture%	CF%	Fat%
T_0	C_1	17.55	3.87^{EF}	6.70^{AB}	82.62	13.76^{E}	1.11
	C_2	22.97	3.65^{EF}	6.29^{B}	78.13	15.11^{DE}	1.49
T_1	C1	20.36	9.54^{A}	7.95^{AB}	85.72	18.36^{AB}	3.56
	C2	17.11	6.37^{BCD}	7.21^{AB}	82.46	19.56^{A}	2.77
T_2	C1	15.88	5.65^{CDE}	8.07^{A}	83.00	17.33^{BC}	2.61
	C2	18.70	4.50^{DEF}	7.68^{AB}	81.26	18.88^{A}	1.60
T_3	C1	14.32	8.12^{AB}	7.00^{AB}	85.54	14.38^{E}	2.53
	C2	23.29	5.17^{DE}	6.40^{AB}	76.67	16.56^{CD}	2.54
T_4	C1	14.08	8.51^{DEF}	7.80^{AB}	84.92	17.22^{BC}	3.39
	C2	20.24	4.55^{DEF}	6.78^{AB}	79.68	19.23^{A}	3.60
T_5	C1	15.47	7.65^{ABC}	7.70^{AB}	84.47	16.87^{C}	2.47
	C2	23.51	2.79^{F}	6.66^{AB}	76.49	19.47^{A}	3.58
SEM		2.25	0.37	0.30	1.74	0.46	0.56
p		0.16	0.1	0.81	0.35	0.65	0.13

DAT indicates day after treatments; C_1 = 60 DAP; C_2 = 90 DAP,-T0 (Control): No fertilizer and manure, T_0 (Control): No fertilizer and manure, T_1: Application of cow dung 100%, T_2: Application of buffalo manure 100%, T_3: Recommended NPK (Urea: 65.217 g, TSP: 17.78g, MOP: 32.27g), T_4: 50% NPK + 50% Cow dung (Cow dung: 3.571 kg, Urea: 32.60g, TSP: 8.89g, MOP: 16.135g), T_5: 50% NPK + 50% Buffalo manure (Buffalo manure: 5.357 kg, Urea: 32.60g, TSP: 8.89g, MOP: 16.135g) NS=non-significant, ***=$p<0.001$, **=$p<0.01$, *=$p<0.05$

It reveals in Table 7 that the highest DM% was found in T_5 (11.37%), while the lowest was found in T_0 (8.91%). Highest crude protein (CP) content was found in T_3 (4.94%), while the lowest was found in T_0 (1.80%) which was significantly ($p<0.01$) differed. Highest ash content was found in T_3 (4.89%), while the lowest was found in T_2 (1.84%) which was highly significantly ($p<0.01$) differed. Highest CF% was found in T_3 (10.17%), while T_1 had the lowest CF% (8.50%) which was significantly ($p<0.02$) differed. Highest fat content was found in T_5(3.74%) and the lowest was found in T_0(1.80%) which was significantly ($p<0.01$) differed.

Table 7: Treatment on nutritional composition of maize's stem

Treatment	DM%	CP%	Ash%	Moisture%	CF%	Fat%
T_0	8.91	1.80^{B}	2.09^{B}	91.09	8.94^{BC}	1.80^{C}
T_1	11.93	4.88^{A}	3.31^{B}	89.67	8.50^{C}	3.59^{A}
T_2	10.70	4.54^{A}	1.84^{B}	89.29	9.36^{B}	3.23^{AB}
T_3	9.34	4.94^{A}	4.89^{A}	90.88	10.17^{A}	3.49^{AB}
T_4	10.41	4.61^{A}	3.31^{A}	89.58	9.08^{BC}	2.31^{BC}
T_5	11.37	3.93^{A}	2.21^{B}	88.63	9.11^{BC}	3.74^{A}
SEM	1.16	0.21	1.07	1.33	0.19	0.26
p	0.46	0.00	0.002	0.76	0.02	0.01
cv	22.20	10.35	43.56	2.98	4.30	17.36

*T_0 (Control): No fertilizer and manure, T_1: Application of cow dung 100%, T_2: Application of buffalo manure 100%, T_3: Recommended NPK (Urea: 65.217 g, TSP: 17.78g, MOP: 32.27g), T_4: 50% NPK + 50% Cow dung (Cow dung: 3.571 kg, Urea: 32.60g, TSP: 8.89g, MOP: 16.135g), T_5: 50% NPK + 50% Buffalo manure (Buffalo manure: 5.357 kg, Urea: 32.60g, TSP: 8.89g, MOP: 16.135g);; NS=non-significant, ***=$p<0.001$, **=$p<0.01$, *=$p<0.05$; DM= Dry matter, CP= Crude protein, CF= crude fiber.*

It is shown in Table 8 that highest DM% found in C_2 (12.49%) and the lowest DM% was found in C_1 (8.39%) which was significantly ($p<0.01$) differed. Highest CP% was found in C_1(5.46%) and the lowest was found in C_2 (2.77%) which was significantly ($p<0.01$) differed. Highest ash% was found in C_1 (5.24%) and the lowest was found in C_2found (4.64%). Highest CF% was found in C_2 (10.21%), while the lowest was found in C_1 (8.18%) which was significantly ($p<0.01$) differed. Highest fat content was found in C_1 (3.36%), while the lowest was in C_2 (2.69%) which was significantly ($p<0.01$) differed.

Table 8: Cutting interval on nutritional composition of maize's stem

Treatment	DM%	CP%	Ash%	Moisture%	CF%	Fat%
C_1	8.39^{A}	5.46^{A}	5.24	92.14^{A}	8.18^{B}	3.36^{A}
C_2	12.49^{B}	2.77^{B}	4.64	87.57^{B}	10.21^{A}	2.69^{B}
SEM	0.66	0.12	0.62	0.77	0.11	0.15
p	0.01	0.00	0.50	0.01	0.00	0.01

*DAT indicates day after treatments; C1 = 60 DAT; C2 = 90 DAP NS=non-significant, ***=$p<0.001$, **=$p<0.01$, *=$p<0.05$; DM= Dry matter, CP= Crude protein, CF= crude fiber.*

It is shown in Table 9 that highest DM% was found in the interaction effect of T_5C_2 (15.62%) and the lowest was found in the interaction effect of T_3C_1 (6.41%). Highest CP% was found in the interaction effect of T_1C_1 (6.53%) and the lowest was found in the interaction effect of T_0C_2 (1.25%). Highest ash% was found in the interaction effect of T_3C_1 (11.49%) and the lowest was found in the combination of T_2C_2 (1.80%). Highest CF% was found in the interaction effect of T_3C_2 (10.70%) and the lowest was found in the interaction effect of T_4C_1 (7.75%) which was significantly ($p<0.05$) differed.

Table 9: Effect of cutting height and cutting interval on nutritional composition of maize's stem

Treatments		DM%	CP%	Ash%	Moisture%	CF%	Fat%
T_0	C_1	7.10	2.36^{BC}	2.20^{B}	92.89	7.76^{D}	2.44^{ABC}
	C_2	10.71	1.25^{C}	1.97^{B}	89.28	10.13^{AB}	1.16^{C}
T_1	C_1	11.66	6.53^{A}	4.21^{AB}	91.55	7.76^{D}	3.84^{AB}
	C_2	12.20	3.23^{B}	2.40^{B}	87.79	9.25C	3.33^{AB}
T_2	C_1	9.88	5.84	1.89B	90.11	8.03^{D}	3.51^{AB}
	C_2	11.52	3.23^{B}	1.80^{B}	88.48	10.70^{A}	2.95^{ABC}
T_3	C_1	6.41	6.51^{A}	11.49^{A}	93.58	9.68^{BC}	4.18^{A}
	C_2	12.27	3.37^{B}	10.29^{AB}	88.19	10.67^{A}	2.81^{ABC}
T_4	C_1	8.17	6.42^{A}	9.61^{AB}	91.81	7.75^{D}	1.94^{BC}
	C_2	12.65	2.80^{BC}	9.01^{AB}	87.34	10.42^{AB}	2.68^{ABC}
T_5	C_1	7.12	5.12^{A}	2.04^{B}	92.88	8.10^{D}	4.23^{A}
	C_2	15.62	2.75^{BC}	2.37^{B}	81.89	10.13^{AB}	3.25^{ABC}
SEM		1.63	0.30	1.52	1.89	0.28	0.37
p		0.25	0.81	0.98	0.61	0.05	0.13

*DAT indicates day after treatments; C_1 = 60 DAT; C_2 = 90 DAP T_0 (Control): No fertilizer and manure, T_1: Application of cow dung 100%, T_2: Application of buffalo manure 100%, T_3: Recommended NPK (Urea: 65.217 g, TSP: 17.78g, MOP: 32.27g), T_4: 50% NPK + 50% Cow dung (Cow dung: 3.571 kg, Urea: 32.60g, TSP: 8.89g, MOP: 16.135g), T_5: 50% NPK + 50% Buffalo manure (Buffalo manure: 5.357 kg, Urea: 32.60g, TSP: 8.89g, MOP: 16.135g); NS=non-significant, ***=$p<0.001$, **=$p<0.01$, *=$p<0.05$; DM= Dry matter, CP= Crude protein, CF= crude fiber.*

CHAPTER V

SUMMARY AND CONCLUSION

5.1 Summary

Maize (*Zea mays*) is one of the most popular forages in the tropics and sub-tropics and also in Bangladesh due to its high yielding performance and nutritional qualities with good adaptability. For this reason, farmers are interested for the cultivation of Maize (*Zea mays*). Considering the facts that the researcher conducted this study entitled "Effect of organic manure on production performance and nutritional composition of Maize (*Zea mays*).

The findings of the study revealed that highest plant height (254.00 cm) was found in T_4 (50% NPK + 50% cow dung). Highest stem length (26.65 cm) was found in T_4 (50% NPK + 50% Cow dung). Highest biomass (83.66 tha^{-1}) was found in T_1 (100% cow dung).The treatments had significant effect ($p<0.05$) on biomass production. Highest plant height was found in C_2 (245.91cm) (90 DAP). The cutting interval has a significant ($p<0.05$) effect on the plant height. Highest stem length was found in C_2 (26.36 cm). The cutting interval has a significant ($p<0.01$) effect on the stem length. The CP% of leaf was highest in C_1 (7.22%) at 60DAP which was significantly ($p<0.01$) differed. Highest CP% of stem was found in C_1 (5.46%) at 60DAP.

5.2 Conclusion

It may be concluded that highest biomass was found in the interaction effect of 100% cow dung at 90 days after planting while highest CP content was found in the interaction of 100% cow dung at 60 days after planting since CP content of forage was reduced with the advancing of age.

CHAPTER VI

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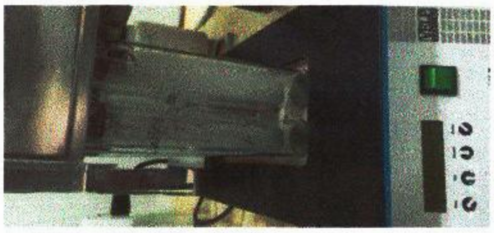
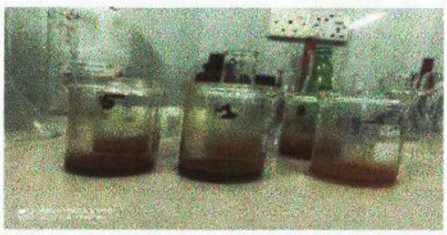
APPENDIX

Research related some picture











Calculation

Fertilizer Recommendation Guide2018, Bangladesh Agricultural Research Council

Factor B

T_0 = No manure and fertilizer

T_1 = 100%Cow dung

T_2 = 100%Buffalo manure

T_3 = Recommended NPK of fertilizer

T_4 = 50% NPK + 50% Cow dung

T_5 = 50% NPK + 50% Buffalo manure

Recommended value:

Nitrogen = 75 kg/ha

$= \{(75\times1000) \div 10000\}$ g/m^2

$= 7.5$ g/m^2

For 4 m^{2}space need = $(7.5\times4) = 30$ g

Phosphorus = 20 kg/ha

$= \{(20\times1000) \div 10000\}$ g/m^2

$= 2$ g/m^2

For 4 m^2 space need = $(2\times4) = 8$ g

Potassium (K) = 40 kg/ha

$= \{(40\times1000) \div 10000\}$ g/m^2

$= 4$ g/m^2

For 4 m^2 space need = $(4\times4) = 16$ g

Now 100% Application

Cow dung

Required value = 30 g Nitrogen

Nitrogen found in sample = 0.42%

0.42 g Nitrogen found from 100g cow dung

1 g Nitrogen found from $(100\div0.42)$ g cow dung

30 g Nitrogen found from {(100÷0.42) ×30} g cow dung = 7142.8571 g cow dung

= 7.142 kg cow dung

Buffalo dung

Found value:

Nitrogen = 0.28%

= 0.28 g found in 100 g buffalo dung

0.28 g Nitrogen found from 100 g buffalo dung

1 g Nitrogen found from (100÷0.28) g buffalo dung

30 g Nitrogen found from {(100÷0.28) ×30} g buffalo dung = 10714.2857 g of buffalo dung

= 10.714 kg of buffalo dung

For NPK:

Nitrogen:

Required value = 30 g

Urea have 46% Nitrogen

46 g Nitrogen found from 100 g Urea

1 g Nitrogen found from (100÷46) g Urea

30 g nitrogen found from {(100÷46) ×30} g Urea = 65.217 g Urea per plot

For Phosphorus

Recommended value = 8 g of Phosphorus

TSP has (44-46) % of Phosphorus

45 g Phosphorus has in 100 g of TSP

1 g Phosphorus has in (100÷45) g of TSP

8 g Phosphorus has in {(100÷45) ×8} g of TSP =17.78 g of TSP per plot

For MOP

Recommended value = 10 g of Potassium (K)

MOP has 60% K_2O or, 49.58% Potassium (K)

49.58 g Potassium found in 100 g of MOP

1 g Potassium found in (100÷49.58) g of MOP

16 g Potassium found in {(100÷49.58) ×16} g of MOP = 32.27 g of MOP

Now

For 50% NPK and 50% Cow dung

Total Nitrogen requirement = 30 g per plot

Here 50% will come from NPK that is 15 g

And 50% will come from cow dung that is 15 g

For NPK:

Nitrogen:

Required value = 15 g

Urea has 46% Nitrogen

46 g Nitrogen found from 100 g Urea

1 g Nitrogen found from (100÷46) g Urea

15 g nitrogen found from {(100÷46) ×15} g Urea = 32.60 g Urea

In same process

P = 8.89 g TSP

K = 16.135 g MOP

Cow dung

Required value = 15 g Nitrogen

Nitrogen found in sample = 0.42%

0.42 g Nitrogen found from 100g cow dung

1 g Nitrogen found from (100÷0.42) g cow dung

15 g Nitrogen found from {(100÷0.42) ×15} g cow dung = 3571.4285 g cow dung

= 3.571 kg cow dung

According to the same process

Buffalo dung required = 5.357 kg

Treatment	Amount of fertilizer and manure
T_0	No fertilizer and manure
T_1	7.142 kg cow dung
T_2	10.714 kg buffalo dung
T_3	Urea: 65.217g, TSP: 17.78 g and MOP: 16.135 g
T_4	Cow dung: 3.751 kg, Urea: 32.60 g TSP:8.89 g, and MOP:16.135 g
T_5	Buffalo dung: 5.357 kg, Urea: 32.60 g, TSP: 8.89 g and MOP: 16.135 g