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Effect of seed rate and water level on production and chemical analysis of hydroponic fodder

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Abstract:

Bangladesh is densely populated country with limited land resources where livestock gets very small places for grazing or large production of fodder is hard. But for getting increased productivity from livestock it is important to serve green grass.

The study was conducted with a view to establishment technology of production and analysis of nutrient component of hydroponic forages with two different seed i. e. maize and wheat.

The treatments comprised of three seed rate of each seed and three water level. The experiment was laid out in a factorial design with 3 replications for each fodder in 27 trays. The unit tray size was 48cm × 36cm. The fodder was harvested at 10th day. Sample was collected for chemical analysis at different days (8,9,10th day). The

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hydroponic forages were produced for observing the yield by different seed rate and water level treatment and chemical composition, digestibility & ME content at different days (8th ,9th, 10th day).

In production among the treatment some combination of treatment was statistically significant (p<.01). Yield parameters included fresh yield were significant (p<0.01) at 10th day harvesting. The highest result in each combination of treatment was recorded. Chemical composition included CP, CF, EE and Ash significant value were recorded for different days. The highest CP, CF, EE and Ash content was observed in Maize and Wheat hydroponic forages at three days were statistically significant (p<0.01, p<.05). The significant value was also calculated for IVOMD and ME contents in three days. It has been observed that the chemical composition at 9th day was superior to other days. On the other hand, in case of wheat 0.4 kg seed rate and 2.5 L water level and incase of maize 0.6 kg seed rate and 2.5 L water level were the best treatment combination among the treatment combination.

So, it can be concluded that high production performances and nutritive value can be found by cultivating hydroponic fodder using two seeds (maize and wheat) in the housing condition and through this process awareness about better feeding as well as feeding of this grass can be build up among farmers which might be able to improve the health status and productivity of livestock in Bangladesh.

Key words: seed rate, water level, production and chemical analysis, hydroponic fodder

INTRODUCTION

Livestock are well integrated into its existing farming system and they are equally important to the farmers' as well as to the national economy in addition to their contribution to the nation's food supply. The scarcity of animal feed and fodder has been identified as a major constraint for the development of livestock in Bangladesh. Poor quality roughage e.g. rice straw comprises 90% of the cattle feed (Tareque and Saadullah, 1988) which is deficient in readily fermentable carbohydrates, protein, minerals and vitamins. As a result, growth rates of milk and meat production of the animals consuming rice straw alone are low and it shows only about 10% of the genetic potentiality of the animal (Leng, 1995). So, on a straw based diet, supplementation of ample amount of green grass is often recommended to fulfill the requirement of animal (Ranjhan & Singh, 1993). Tudor et al. (2003) examined the feeding of hydroponically sprouted barley on a property in the Gascoyne Pilbara region of Western Australia, involving 17 Droughtmaster steers (15 & 18 months old and averaging 330 kg live weight) which received low quality hay and barley sprouts over 70 days. He reported that, over the first 48 days' cattle ate 1.9 kg DM/head/day of sprouts (15.4 kg wet weight) and 3.1 kg DM/head/day of poor quality hay and gained 1.01 kg/head/day. Energy intake was 47 MJME/ head/ day, which was considered by nutrition standards to only be sufficient for low weight gains of up to 200 g/ head/ day. Flavio Raccanello, Toowoomba, reported that, daily feeding of 1.0 kg Barley, germinated to yield 7.0 kg fresh weight of sprouts, to Angus cross heifers (200 kg BW) in a badly drought-affected paddock of Rhodes grass for 100 days yielded 0.75 kg/ day ADG. This equates to 0.5% BW Grain or 3.5% BW Sprouts, as a supplement to poor paddock feed.

Improved milk yields in herds with a very low quantity & quality of alternative feed available, increases in milk fat levels and improved conception rates in milking heifers and cows on poor quality pastures by intake hydro-phonic fodders (Shipard, 2005).

Nowadays our farmers are interested in rearing cross-bred animal. Therefore, feeding green forage is essential for having increased productivity of our animals. Presently in Bangladesh, about 83% of the total cultivable land is used for cultivation of cereal crops and only 0.10% for cultivation of fodder crops and the rest for other crops (BBS, 2014). As a result, fodder shortage for our animal is aggravating day by day and recently has emerged out as an acute problem for rearing of livestock. To face all these challenges, it is a better approach to cultivate hydroponic fodder in a small house within a short time. According to Shipard (2005), Sprouts help to alkalise the body and neutralise acidic wastes, thus assisting the body to heal itself and develop a stronger immune system. Just as most plants grow well in neutral pH soils, so too can animals be more productive if given alkaline feeds. It is believed that in an acid state, body cells cannot adequately take in nutrients and oxygen, and they cannot effectively expel toxins. An overly acid state reduces the amount of oxygen and nutrients that the cells can receive. When a cell is oxygen deprived, various types of serious health problems may be created". An increase in lipase activity has been reported in barley by MacLeod and White (1962), as cited by Chavan and Kadam (1989). Increased lipolytic activity during germination and sprouting causes hydrolysis of triacylglycerols to glycerol and constituent fatty acids . On the surface, the concept of putting one kilogram of grain into a hydroponic system and producing 6 to 10 kilograms of lush green sprouts, independent of weather and at any time of year, is appealing ,Tyler(2003). Though it seems like growing a lot of feed, the increase in fresh weight is due to water and most often there is a reduction in dry matter weight compared with the initial grain Stephen (2003). Hydroponically sprouting grain is less a case of growing feed and more a case of buying in grain and spending additional, sizeable quantities of time and money to change its quality and reduce its dry matter weight, Tony Koch ,Geoff Tudor(2005). The economics and application of such a production system should be carefully examined. Producing hydroponic fodder in Bangladesh can be a feasible way to minimize shortage of green fodder supply to cattle

MATERIALS AND METHODS

The experiment was conducted at the fisheries faculty in BAU, Mymensingh to study the production and nutritive value of hydro-phonic fodder.

Experimental Period and Experimental Site

The field experiment was conducted during the period from February to July 2015 and the laboratory analyses were done from July to October, 2015.

Location

Fodder production experiment was conducted in a newly built experimental house in the faculty of Fisheries, Bangladesh Agricultural University, Mymensingh. Chemical analysis of fodders was conducted in the animal nutrition analytical laboratory, Department of Animal Nutrition, Bangladesh Agricultural University, Mymensingh.

Climatic Condition

The experimental house is situated under sub-tropical climate. Usually the rainfall is heavy during April to September and scanty in October to March season. January to March season starts with low temperature and 8-10 hours of sunshine, the atmospheric temperature increases from June to September (above 80%) and declined in winters.

Experimental Details

Treatments

In case of wheat seed the amount of seed was 350g, 400g and 450g respectively. In case of maize seed the amount were 400g, 500g and 600g.Water level were 1.5L, 2L and 2.5L in both cases (wheat and maize).

Experimental Design and Layout

The experiment was laid out in a factorial design with 3 replications. The size of each tray was 1728 cm^2 (48cm × 36cm). Total 27 trays were organized in shelf. Each treatment tray was organized vertically. Each treatment had three trays in a segment. All treatment trays placed different place in the room. The total organization is given bellow.

Replication No: 01

T_1Ty_1	T_2Ty_1	T_3Ty_1
T_1Ty_2	T_2Ty_2	T_3Ty_2
T_1Ty_3	T_2Ty_3	T_3Ty_3

Replication No: 02

T_1Ty_1	T_2Ty_1	T_3Ty_1
T_1Ty_2	T_2Ty_2	T_3Ty_2
T_1Ty_3	T_2Ty_3	T_3Ty_3

Replication No: 03

T_1Ty_1	T_2Ty_1	T_3Ty_1
T_1Ty_2	T_2Ty_2	T_3Ty_2
T_1Ty_3	T_2Ty_3	T_3Ty_3

Fig. 3.1: **Layout of the experiment**

Here, T1 (1.5L), T2 (2L), T3 (2.5L) are the water treatment.

Ty_1, Ty_2, Ty_3 are the tray number that contain different seed rate in case of wheat those were 350g, 400g, 450g. In case of maize it were 400g, 500g, 600g.

Preparation of Tray and Shelf

Trays were made from tin sheet in 48cm long and 36cm wide. Tray was poured in one side so that water can be removed rapidly. Shelf was made in such slope so that water can be poured in another tray that stayed in the bottom side .Shelf was made around the inside of shed .It was made of local instrument at a least cost .Bamboo was used to made the shelf .Three shelf was made in each side of the shed .Well drainage system was perform .There was enough ventilation system for proper light and air.

Seed collection, preparation and germination

Seed of wheat and maize were collected from local market at Mymensingh sadar in a reasonable prize. These seed were sundried in a few time to turn its DM at 12-14%.This DM% is better for storage and germination. After weighing the seeds were washing with freshwater in 2 times in a bucket .Then the seeds were soaking with lemon juice for 40 minutes. After 40 minutes the seeds were washing again two times with fresh water .Then soaking the seeds into fresh water at least 12 hours. After 12 hours water was removed and was taken place without water at least 1 hour. This is the breathing time of the seeds and it helps in proper germination. After breathing time seeds were placing into gunny bag. Here stayed 24 hours for proper germination.24 hours later germination were occurred and then seeds were transplanted on trays.

System Operation

System operation related to hydro-phonic fodder production sample collection are discussed below.

The daily operation of the fodder shed involves the following tasks:

1. At first seeds were weighing after buying from the market.
2. The seeds were washing with fresh water in two times.
3. Those seeds were soaking with lemon juice for 40 minutes at the rate of 5-10ml per liter.
4. After soaking with lemon juice again seeds were washing with fresh water at least 1-2 times.
5. Then passing away breathing time about one hour.
6. After breathing time the seeds were placing into gunny bag(24 hours for wheat seed and 48 hours for Maize seed).
7. At that time germination occurred properly then seeds were placing in the trays through spreading.
8. Water were given timely. The sample were collected at 8^{th} , 9^{th} and 10^{th} days for proximate analysis. Lastly harvested at 10^{th} day and recorded the production data.

Irrigation

Irrigation was done in 6 hours interval in a day. First two days only spray was performed. After two days water was applied according to the treatments.

Harvesting:

After 8, 9 and10 days of transplantation the samples of fodders were collected for proximate analysis and in-vitro digestibility. Finally, after 10 days hydro-phonic fodder were harvested and total production was calculated on DM basis.

Recording of Data

Biomass Yield of Fodder

Immediately after harvesting the fodder, fresh yield was recorded by weighing on a balance and yield was expressed in Kg/1Kg.

Sampling

Sampling during Harvesting

During harvesting a particular amount of fodder was taken randomly for sun drying and also for laboratory analysis of proximate components.

Preparation of Samples for Laboratory Analysis

The samples of fodders were dried before grinding. After grinding, the samples were kept in the polyethyene bags, labeled and stored for further analysis.

Laboratory work

Chemical Analysis for Proximate Components

The samples of fodders were analyzed for DM (Dry matter), CP (Crude protein), CF (Crude fiber), NFE (Nitrogen free extract), EE (Ether extract) and Ash following the method of AOAC (2004).

Determination of in-vitro organic matter digestibility and metabolizable energy (ME)

In vitro organic matter digestibility (IVOMD) and metabolizable energy (ME), were determined by the methods of Menke and Steingass (1988) and calculated by using the following equations:

$$IVOMD = 16.49 + 0.9042\ GP + 0.0492\ CP + 0.0387\ TA$$
$$ME = 2.20 + 0.1357\ GP + 0.0057\ CP + 0.000286\ EE^2$$

Where, IVOMD (DO) = In vitro organic matter digestibility (%), ME = Metabolizable energy (MJ/kg DM), GP = Gas production is expressed in ml per 200 mg DM, CP = Crude protein (g/kg DM), TA = Total ash (g/kg DM), EE = Ether extract (g/kg DM)

Statistical Analysis

The recorded data were compiled and tabulated for statistical analysis. The collected data were statistically analyzed using "Analysis of Variance" technique with the help of computer program, MSTAT. The significance of mean differences among the treatments was done by Duncan's Multiple Range Test (DMRT) and Least Significant Difference (LSD) Test (Gomez and Gomez, 1984).

RESULTS AND DISCUSSION

Biomass Yield of Hydro-phonic forages

Maize

Yield of maize fodder in different treatment combinations at 10^{th} day of harvesting are presented in Table 4.1. The data in the table shown that there were significant($p<.01$) variation in yield of forage among the different combinations of wheat in terms of seed rate and water level.

The highest yield was observed in the treatment combination A3T3 (6.22kg) containing 0.6kg seed and 2.5L of water and the lowest yield was given by the treatment A1T1 (4.42kg) having 0.4kg seed and 1.5L of water. The yield of treatment A3T3 (6.22kg) was significantly (p<.01) higher than those of the other treatments except A3T1 (5.58kg) having 0.6kg seed and 2.5L of water which gave the second highest yield of forage. Positive response of maize seed rate and water level enhances growth of forage might be reason for the highest yield. The highest fresh yield of wheat forage might be due to the highest plant height, leaf length and number of root of this forages. Production of maize forage by combination of different treatments are shown graphically in figure 1.

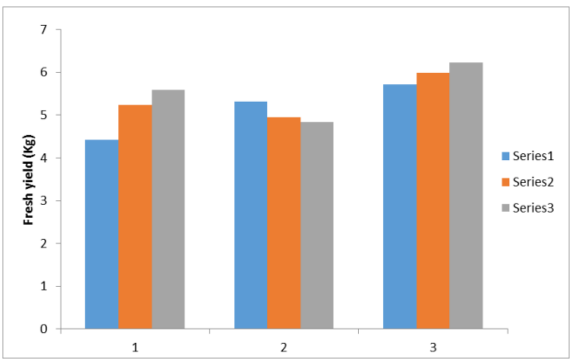

Fig. 1: Comparison on fresh yield of Maize in different treatments.
Here, Series 1=A1, Series 2=A2, Series 3= A3 and 1=T1, 2=T2, 3=T3

The growing cycle of sprouting maize, the main visible change was the increase in root length and thickness. The average green forage yield ranged from 4.93 kg per kg of barley grain at day 6 to 7.21 kg at day 8. The production conversion ratio, based on the amount of fresh fodder produced per unit of seed used, could be approximately 4 to 8 times Morgan and Hunter (1992) , Peer and Lesson (1985).We got highest 6 times and lowest 4 times folds in fresh basis .We also got some lower amount due to experimental period .Some factors were responsible for that lower production such as manage factors

,environmental factors, seed quality etc .We conducted manual management and use local seed so that farmers can adapt this technology easily. Nevertheless, lower amount of green forage to seed ratio was reported by Al-Ajmi et al. (2009) and Al-Hashmi (2008) who obtained a ratio of 2.76 to 3 kg green fodder per kg of barley seed. This ratio depended on the several factors such as management, type and quality of grain, amount and frequency of irrigation, nutritious solution, temperature, humidity, density and position of lights, bulk of seeds on each tray and number of days allowed to grow Truby (1969), Huballi and Molla(2010).

Table 4.1: Forage Yield (Kg/1Kg) of maize and wheat in different treatment of combinations of seed rate and water level

Production	Combination of Treatment									SED	Level of significance
	A_1T_1	A_1T_2	A_1T_3	A_2T_1	A_2T_2	A_2T_3	A_3T_1	A_3T_2	A_3T_3		
Wheat	4.36_g	5.52_f	5.74_e	5.82_b	5.91_b	6.74_a	4.72_d	4.95_c	5.83_a	1.43	**
Maize	4.42	5.32	5.71	5.23	4.95	5.98	5.58	4.83	6.22	2.12	**

For Wheat: A1= 350gm, A2= 400gm, A3= 450gm, For Maize: A1= 400gm, A2= 500gm, A3= 600gm, In both cases, T1= 1.5L, T2= 2L, T3= 2.5L
1% significance ** 5% significance *

Wheat

Yield of wheat fodder in different treatment combinations at 10th day of harvesting are presented in Table 4.1. The data in the table shown that there were significant($p<.01$) variation in yield of forage among the different combinations of wheat in terms of seed rate and water level. The highest yield was observed in the treatment combination A2T3(6.74kg) containing 400 gm seed and 2.5L of water and the lowest yield was given by the treatment A1T1(4.36) having 350gm seed and 1.5L of water. The yield of treatment A2T3 (6.74kg) was significantly($p<.01$) higher than those of the other treatments except A3T3(5.83kg) having 450gm seed and 2.5L of water which gave the second highest yield of forage. Positive response of wheat seed rate and water level enhances growth of forage might be another reason for the highest yield. The highest fresh yield of wheat forage might be due to the highest plant height, leaf length and number of root of this forages. Production of Wheat forage by combination of different treatments are shown graphically in Figure2.During the production cycle of sprouting wheat, the main visible change was the increase in root length and thickness. The average green forage yield ranged from 4.93 kg per kg of barley grain at day 6 to 7.21 kg at day 8. The production conversion ratio, based on the amount of fresh fodder produced per unit of seed used, could be approximately 4 to 8 times Morgan and Hunter 1992, Peer and Lesson 1985. Production was not so high due to different factors. We cultivated the hydro-phonic forages manually so that local farmers can adapt the cultivation technology so easily. Rural farmers will use local seed so we conducted the experiment using local seed. Seed quality is very important factor that affect largely in production. Then management and environment also affect in production. Truby 1969, Huballi 2010 and Molla 2010 stated that the ratio depended on the several factors such as management, type and quality of grain, amount and frequency of irrigation, nutritious solution, temperature, humidity, density and position of lights, bulk of seeds on each tray and number of days allowed to grow.

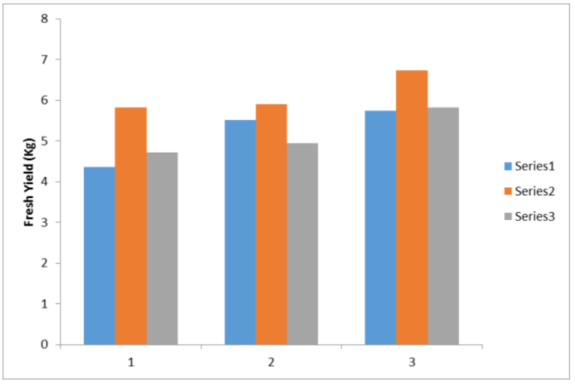

Fig. 2. Comparison on fresh yield of Wheat in different treatments

Here, Series 1=A1, Series 2=A2, Series 3= A3 and 1=T1, 2=T2, 3=T3

Chemical Composition of hydro-phonic forages

Maize Forage

Dry Matter (Fresh basis) (g/100g)

Dry Matter Yield percentage of maize plant and root in different days(8^{th} ,9^{th} and 10^{th} day) are presented in Table 4.2.The data in the table shown that there were significant(p<.05 and p<.01) variation in yield dry matter of plant and root of maize forage among the different days(8^{th} ,9^{th} and 10^{th} day).The highest yield was observed in 10^{th} day in both plant(94.88g) and root(98.98g).Incase maize plant the yield of DM at 10^{th} day was significantly(p<.05) higher than those of the other days .On the other hand in maize root the yield of DM at 10^{th} day was significantly (p<.01) higher than those of the other days. These results were in accordance with those of Bautista 2002, and Morgan et al. 1992, who reported a significant differences in wet weight (WW) and dry weight (DW) of the hydroponic fodder. According to Peer and Leeson 1985, freshweight increased from 1.72 times of the original seed weight, after sprouting for 1 day, to 5.7 folds after 7 days but a negative relation was found in DM content with but a negative relation was found in DM content with limitation effect on intake of GF when fed to animals.

Crude Protein (g/100g DM)

CP Yield percentage of maize plant and root in different days(8^{th} ,9^{th} and 10^{th} day) are presented in Table4.2.The data in the table shown that there were no significant variation in CP yield of plant and root of maize forage among the different days(8^{th} ,9^{th} and 10^{th} day).The highest yield was observed in 8^{th} day incase of plant(24.07g/100g).Incase of root the highest yield was observed at 10^{th} day(9.23g/100g).Increasing days in soaking condition CP percentage increases. In agreement with Flynn et al. (1986) as cited by Morgan et al. (1992), the CP content increases progressively with age, reaching a maximum of 48%

on day 8.The CP obtained in this study was comparable with those reported by Al-Ajmi et al. 2009, who found about 14 percent reported by Al-Ajmi et al. 2009, who found about 14 percent al. [Morgan1992] reported that CP content was increased from 10.8 at day 4 to 14.9 percent at day 8 in hydroponically barley fodder that were in accordance with our findings But, Snowet al. 2008, reported a higher (16.13%) CP content, in hydroponically barley fodder. The CP contents could be affected by the cultivation conditions in hydroponic systems. Sneath and McIntosh 2003, evaluated the composition of sprouted barley and reported that the CP ranged from 11.38 to 24 percent. However, protein content may be influenced as a result of the nitrogen supplementation and other nutrients changes in sprouting grains.

Crude Fiber (g/100g DM)

Crude Fiber content of maize plant and root in different days (8^{th} ,9^{th} and 10^{th} day) are presented in Table 4.2.The data in the table shown that there were significant($p<.01$) variation in CF content of plant and root of maize forage among the different days(8^{th} ,9^{th} and 10^{th} day).The lowest CF content was observed at 8^{th} day incase of plant(18.17g/100g) in both plat and root. Increasing day fiber content relatively increases in plant. According to Kent and Amos (1967), after 6 days of growing, starch accounted for 53-67% of the dry weight of barley seed, so any decrease in the amount of starch would cause a corresponding decrease ..Incase maize plant the yield of CF at 8^{th} day was significantly($p<.01$) lower than those of the other days .On the other hand in maize root the yield of CF at 10^{th} day was significantly ($p<.01$) lower than those of the other days. By enhancing the time of sprouting, the higher organic matter, particularly starch consumed to support the metabolism and energy requirement of the growing Chavan and Kadam (1989), therefore resulted in a lower OM and higher Ash in sprouted grain. From the present study it is distinctly visible that that the CF contents of all the grasses increase with the day to day of maturity. This might be due to the effect of successive cell wall concentration with the increasing stages of maturity.

Ether Extract (g/100g DM)

Ether Extract content of maize plant and root in different days(8^{th} ,9^{th} and 10^{th} day) are presented in Table 4.2.The data in the table shown that there were significant($p<.01$) variation in EE content of plant and root of maize forage among the different days(8^{th} ,9^{th} and 10^{th} day).The highest yield was observed at 9^{th} day in plant(8.48g) and in root the highest was observed at 8^{th} day(4.10g).Incase of maize plant the EE content at 9^{th} day was significantly($p<.01$) higher than those of the other days .On the other hand in maize root the yield of DM at 10^{th} day was significantly ($p<.01$) higher than those of the other days .Ether Extract is associated with different components. The increase in EE could be due to the production of chlorophyll associated with plant growth that are recovered in ether extract measurement Mayer and Mayber (1975). Such changes in nutrients profile and recovery are misleading, since they only described the alterations in the proportion since they only described the alterations in the proportion change in weight of any one of the nutrient leaded to proportional changes in other compositions. During the germination and early stage of plant growing, starch was catabolized to soluble sugars for use in respiration and cell-wall synthesis Hiller and Perry (1969).

Ash (g/100g DM)

Ash content of maize plant and root in different days(8^{th} ,9^{th} and 10^{th} day) are presented in Table 4.2.The data in the table shown that there were significant($p<.01$) variation in ash content of plant and root of maize forage among the different days(8^{th} ,9^{th} and 10^{th} day).The highest yield was observed at 9^{th} day in plant(7.11g) and in root the highest was observed at 10^{th} day(1.89g).Incase of maize plant the EE content at 9^{th} day was significantly(p<.01) higher than those of the other days .On the otherhand in maize root the yield of DM at 10th day was significantly (p<.01) higher than those of the other days. Morgan etal. (1992), found that Ash content of sprouts increased from day 4 corresponding with the extension of the root, which allowed mineral uptake. They reported that Ash content changed from 2.1 in original seed (barley) to 3.1 and 5.3 at day 6 and 8 respectively that were relatively similar to our finding.

Wheat Forage

Dry Matter (Fresh basis) (g/100g)

Dry Matter Yield percentage of wheat plant and root in different days (8th , 9th and 10th day) are presented in Table 4.2.The data in the table shown that there were significant (p<.01) variation in yield dry matter of plant and root of wheat forage among the different days(8th , 9th and 10th day).The highest yield was observed at 9th day in both plant (94.38g) and root (95.02 g).Incase wheat plant the yield of DM at 9th day was significantly(p<.01) higher than those of the other days .On the other hand in maize root the yield of DM at 10th day was significantly (p<.01) higher than those of the other days .These results were in accordance with those of Bautista 2002, and Morgan et al. 1992, who reported a significant differences in wet weight (WW) and dry weight (DW) of the hydroponic fodder. According to Peer and Lesson 1985, fresh weight increased from 1.72 times of the original seed weight, after sprouting for 1 day, to 5.7 folds after 7 days.

Crude Protein (g/100g DM)

CP Yield percentage of wheat plant and root in different days(8th ,9th and 10th day) are presented in Table 4.2.The data in the table shown that there were significant(p<.05 and p<.01) variation in CP yield of plant and root of maize forage among the different days(8th ,9thand10thday).The highest yield was observed at 9thday incase of plant(31.74g/100g).Incase of root the highest yield was observed at 10th day(21.94g/100g) and the second highest value was observed at 8th day(20.63g) . Incase of wheat plant the yield of CP at 9th day was significantly($p<.05$) higher than those of the other days .On the other hand in Wheat root the yield of CP at 10th day was significantly ($p<.01$) higher than those of the other days. The CP obtained in this study was comparable with those reported by Al-Ajmi et al. (2009), who found about 14 percent reported by Al-Ajmi et al. (2009), who found about 14 percent al. Morgan(1992) reported that CP content was increased from 10.8 at day 4 to 14.9 percent at day 8 in hydroponically barley fodder that were in accordance with our findings But, Snowet al. (2008), reported a higher (16.13%) CP content, in hydroponically barley fodder . The CP contents could be affected by the cultivation conditions in hydroponic systems. Sneath and McIntosh (2003), evaluated the composition of sprouted barley and reported that the CP ranged from 11.38 to 24 percent. However, protein content may be influenced as a result of the nitrogen supplementation and other nutrients changes in sprouting grains.

Crude Fiber (g/100g DM)

Crude Fiber content of wheat plant and root in different days(8th ,9th and 10th day) are presented in Table 4.2.The data in the table shown that there were significant($p<.01$) variation in CF content of plant and root of wheat forage among the different days(8th ,9th and 10th day).The lowest CF content was observed at 8th day incase of plant(20.02g/100g) and incase of root(8.67g/100g).Increasing day fiber content relatively increases in plant. According to Kent and Amos (1967), after 6 days of growing, starch accounted for 53-67% of the dry weight of barley seed, so any decrease in the amount of starch would cause a corresponding decrease .Incase wheat plant the yield of CF at 8th day was significantly($p<.01$) lower than those of the other days .On the other hand in wheat root the yield of CF at

8th day was significantly (p<.01) lower than those of the other days. In both cases the value were significantly(p<.01) higher at 9th day(24.19g and13.83g) than those of other days. By enhancing the time of sprouting, the higher organic matter, particularly starch consumed to support the metabolism and energy requirement of the growing Chavan and Kadam (1989), therefore resulted in a lower OM and higher Ash in sprouted grain. From the present study it is distinctly visible that that the CF contents of all the grasses increase with the day to day of maturity. This might be due to the effect of successive cell wall concentration with the increasing stages of maturity.

Ether Extract (g/100g DM)

Ether Extract content of wheat plant and root in different days(8th ,9th and 10th day) are presented in Table 4.2.The data in the table shown that there were significant(p<.01) variation in EE content of plant and root of wheat forage among the different days(8th ,9th and 10th day).The highest yield was observed at 9th day in plant(6.34g) and in root the highest value was observed at 8th day(9.45g).Incase of wheat plant the EE content at 9th day was significantly(p<.01) higher than those of the other days .On the other hand in wheat root the yield of EE at 10th day was significantly (p<.01) higher than those of the other days .Ether Extract is associated with different components .The increase in EE could be due to the production of chlorophyll associated with plant growth that are recovered in ether extract measurement Mayer and Mayber 1975. Such changes in nutrients profile and recovery are misleading, since they only described the alterations in the proportion since they only described the alterations in the proportion change in weight of any one of the nutrient leaded to proportional changes in other compositions. During the germination and early stage of plant growing, starch was catabolized to soluble sugars for use in respiration and cell-wall synthesis Hiller and Perry 1969.

Ash (g/100g DM)

Ash content of wheat plant and root in different days(8th ,9th and 10th day) are presented in Table 4.2.The data in the table shown that there were no significant variation in ash content of plant but there were significant($p<.01$) variation in root of wheat forage among the different days(8th ,9th and 10th day).The highest yield was observed at 10th day in root(3.15g) .Incase of wheat plant the EE content result was non significant. On the other hand in wheat root the yield of ash at 10th day was significantly ($p<.01$) higher than those of the other days. Morganet al.1992, found that Ash content of sprouts increased from day 4 corresponding with the extension of the root, which allowed mineral uptake. They reported that Ash content changed from 2.1 in original seed (barley) to 3.1 and 5.3 at day 6 and 8 respectively that were relatively similar to our finding.

Table4.2: Nutrient composition of maize and wheat hydroponic forages

	Wheat									
	Plant					**Root**				
Different Days	DM	CP	CF	EE	ASH	DM	CP	CF	EE	ASH
(8th day)	88.82c	28.72b	20.02c	4.74b	4.91	93.03b	20.63a	8.67c	9.45a	2.61b
(9th day)	94.38a	31.74a	24.19a	6.34a	4.93	95.02a	13.05b	13.83a	4.98ab	2.83b
(10th day)	90.55b	21.86c	22.08b	4.33c	4.57	92.35c	21.94a	12.69b	4.14b	3.15a
SEM	0.82	1.68	0.61	0.31	0.08	0.40	1.44	0.86	0.82	0.08
Level of sig.	**	*	**	**	NS	**	**	**	**	**
Maize										
	Plant					**Root**				
Different Days	DM	CP	CF	EE	ASH	DM	CP	CF	EE	ASH
(8th day)	93.96c	24.07	18.17c	5.15c	6.34ab	97.93b	7.11	6.12ab	4.10a	1.57b
(9th day)	94.12b	23.36	19.93b	8.48a	7.11a	97.98b	7.87	6.62a	3.80b	1.59b
(10th day)	94.88a	15.67	22.34a	6.07b	6.16b	98.98a	9.23	9.02b	3.51b	1.89a
SEM	0.16	1.97	0.61	0.50	0.15	0.18	0.45	0.45	0.09	0.05
Level of sig.	*	NS	**	**	**	**	NS	**	**	**

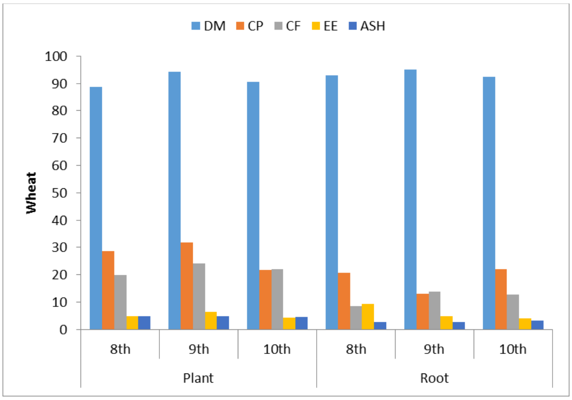

Fig. 3. Comparison of different nutrients of wheat in different days

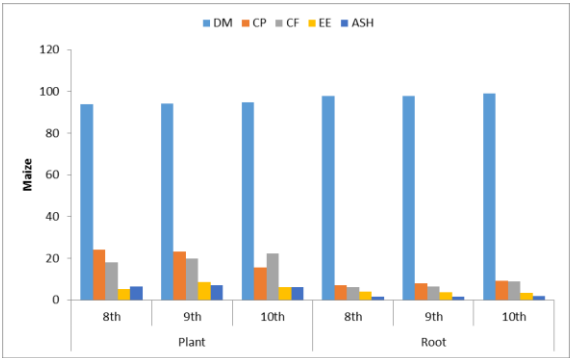

Fig. 4. Comparison different nutrients of Maize in different days

In Vitro Organic Matter Digestibility and Metabolizable Energy of Hydro-phonic fodder

In Vitro Organic Matter Digestibility (%)

Maize

IVOMD percentage of maize plant and root in different days(8th ,9th and 10th day) are presented in Table 4.3.The data in the table shown that there were significant(p<.01) and non significant variation in yield of IVOMD of plant and root of maize forage among the different days(8th ,9th and 10th day).The highest yield was observed at 8th day in plant(36.88%) and in root the value was non significant. In maize plant the yield of IVOMD at 8th day was significantly($p<.01$) higher than those of the other days .The differences in digestibility was significant ($p<0.01$) only for the GF harvested at 8 day growing period. Reduction in digestibility could be as a result of the higher fiber fractions and lower NFC in green forage comparing to the initial barley grain. Such reduction in digestibility could be as a result of components changes in GF where the NFC was decreased but fiber fractions were increased. Other reports: Mansbridge and Gooch 1985; Grigor'ev et al. 1986; Cuddeford 1989 shown that in vitro digestibility of hydroponically grown barley at 6 to 8 days growing periods ranged 72-76 that were comparable to our findings. The DM digestibility could be influenced by the proportion of germinated barley. Peer and Leeson (1985), reported significant losses in DM digestibility of sprouting grains, which declined progressively during a 7 to 8-day growth cycle.

Wheat

IVOMD percentage of wheat plant and root in different days(8th ,9th and 10th day) are presented in Table4.3.The data in the table shown that there were significant($p<.05$) variation in IVOMD percentage of plant and root of wheat forage among the different days(8th ,9th and 10th day).The highest yield was observed at 8th day in plant(41.58%) and in root was at 10th day(33.42%).Incase of wheat plant the yield of IVOMD at 8th day was significantly($p<.05$) higher than those of the other days .On the otherhand in maize root the yield of IVOMD at 10th day was significantly ($p<.05$) higher than those of the other days.Morgan et al. (1992) states, "Other researchers (Flynn et al. 1986 and Peer and Leeson 1985a) reported more significant losses in dry matter digestibility, which declined progressively during a 7 to 8-day growth cycle. In agreement with Peer and Leeson (1985a) digestibility of 4-day old sprouts was superior to whole barley. Flynn and O'Kiely (1986) recorded an 8.6% reduction in digestibility of 8-day old sprouts, probably due to increasing fiber content with age. In feeding trials Peer and Leeson (1985) pigs fed on 4-day old sprouts gained significantly less weight than those fed barley grain. These trials indicated few positive effects due to sprouting and it was concluded that sprouted barley was inferior to whole barley in feed value."

Metabolizable Energy (MJ/kg DM)

Maize

ME content of maize plant and root in different days(8th ,9th and 10th day) are presented in Table4.3.The data in the table shown that there were significant($p<.01$) and non significant variation in ME content of plant and root of maize forage among the different days(8th ,9th and 10th day).The highest ME yield was observed at 8th day in plant(5.46MJ/kg DM) and in root the value was non significant. In maize plant the percent of ME at 8th day was significantly($p<.01$) higher than those of the other days .(comparison of ME value in different days in figure5,6).There are few reports about the ME value of hydroponic fodder, it was reported that the values for ME were around 2.77Mcal/kg DM Mansbridge , Gooch 1985 and 2.92 Mcal/kg DM Cudderford 1989 that were in accordance with our results.

Wheat

ME content of wheat plant and root in different days(8th ,9th and 10th day) are presented in Table 4.3.The data in the table shown that there were significant($p<.05$) variation in ME content of plant and root of wheat forage among the different days(8th ,9th and 10th day).The highest yield was observed at 8th day in plant(6.20MJ/kgDM) and in root was at 10th day(4.93MJ/kgDM).Incase of wheat plant the ME content at 8th day was significantly($p<.05$) higher than those of the other days .On the other hand in maize root the ME content at 10th day was significantly ($p<.05$) higher than those of the other days. The values for ME were around 2.77Mcal/kgDM

Mansbridge Gooch 1985 and 2.92 Mcal/kg DM Cudderford 1989 that were in accordance with our results.

Table 4.3. In Vitro Organic Matter Digestibility (%) and Metabolizable Energy (MJ/ kg DM) contents of wheat and maize in different days

Different Days	Wheat				Maize			
	Plant		Root		Plant		Root	
	IVOMD	ME	IVOMD	ME	IVOMD	ME	IVOMD	ME
8th	41.58a	6.20a	26.89b	4.10ab	36.88a	5.46a	35.40	4.75
9th	34.06b	5.05b	18.54c	2.63b	32.58b	4.82ab	33.47	4.96
10th	34.84ab	5.15b	33.42a	4.93a	30.80c	4.54b	34.76	4.63
SEM	1.45	0.23	2.62	0.40	0.95	0.15	0.40	0.14
Level of sig.	*	*	*	*	**	**	NS	NS

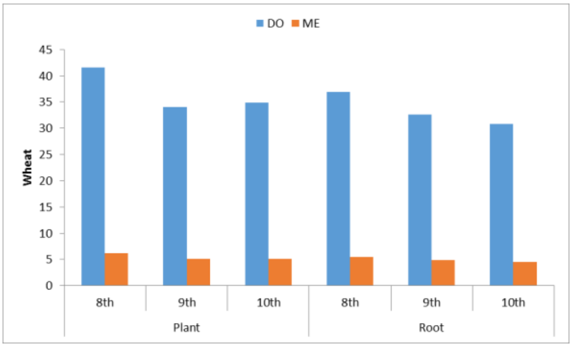

Fig. 5. Comparison of IVOMD (%) and ME(MJ/kg DM) in Wheat plant and root at different days

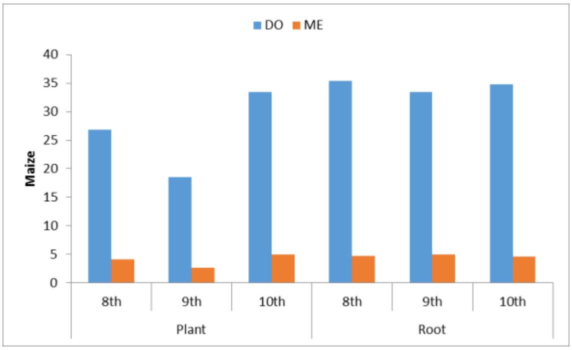

Fig. 6. Comparison of IVOMD (%) and ME(MJ/kgDM) in maize plant and root at different days

CONCLUSION

An experiment was conducted at Fisheries Faculty in Bangladesh Agricultural University with hydro-phonic fodder to compare its production performance, nutritional composition, digestibility and energy value for introducing and adopting the fodder production system by the small holder farmers in a small house. The experiment was held in that place from February to July 2015 and laboratory analysis was done from July to October 2015 in the analytical laboratory of the department of Animal Nutrition.

Wheat and Maize were selected for the study and cultivated in factorial design having three replications for each fodder in 27 trays. Each tray was of 48×36 cm^2 which were decorated in bamboo made shelves. There were two types of treatment in experiment. One was seed rate treatment and another was water level treatment Each treatment had three different amount of seed and water level. Total yield was calculated at tenth day and sample were collected for proximate analysis and invitro-digestibility at 8^{th} ,9^{th} and 10^{th} day. From that analysis, we were calculated the nutritional variation of hydro-phonic fodder in different days (8^{th} ,9^{th} and 10^{th} day). The Hydroponic fodder were compared in some parameters viz. yield, chemical composition, digestibility and energy value.

The yield parameter included fresh biomass yield, dry biomass yield, crude protein yield and crude fiber yield where all differed significantly ($P< 0.01$). The highest production from wheat was 6.74kg from 1 kg wheat seed. In case of maize the production was 6.22kg from 1 kg maize seed. The chemical composition (DM, CP, CF, EE and Ash) and IVOMD, ME were in different amount in different days in maize and wheat hydro-phonic fodder.

In this experiment, it has been observed that the highest biomass yield of wheat came out the combination of seed treatment A2(0.4kg) and water level treatmentT3(2.5L). On the other hand, in maize the best production came out by the seed treatmentA3(0.6kg) and water treatment T3 (2.5L).

Considering all the parameters studied it may be advocated seed rate treatment A2(0.4kg) is the best in case of wheat production and in maize production A3(0.6kg) is the best. On the other hand, the water treatment T3(2.5L) is the best in both hydroponic fodder.

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