EVALUATION OF GROWTH, YIELD, NUTRITIVE VALUE AND COST OF PRODUCTION OF MAIZE FODDER GROWN UNDER HYDROPONIC SYSTEMS

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Abstract

The present study aimed to evaluate the growth, yield, nutritive value and cost of production of maize fodder under hydroponic system. Maize fodder was produced in nine days from planting to harvest by hydroponic technique. Shoot and root length of hydroponic fodder maize were meausred during successive days of growth and on the ninth day of cultivation shoot and root length were 26 cm and 19.60 cm respectively. The yield of maize fodder per kg seed recorded on the ninth day of cultivation was 4.72 kg. Dry matter, crude protein, ether extract, crude fiber, NFE, total ash and acid insoluble ash levels were 17.26, 13.01, 3.47, 8.72, 71.89, 2.95 and 0.53 per cent, respectively on ninth day of cultivation. The crude protein, ether extract, total ash and acid insoluble ash contents of hydroponic maize fodder was higher (P<0.05) than maize seed. The cost of production per kg of hydroponic maize fodder was Rs.5.26.

Key words: *Hydroponics fodder, growth, yield, nutritive value, cost of production*

Quantitative and qualitative deficiency of feeds and fodders is one of the major constraints for development of dairy farming in India. Conventional feed and fodder resources are not enough to bridge this gap. Moreover, due to higher population growth and its consequential pressure on land, area available for grain and forage production is decreasing day by day. As an alternative to conventional method, grains can be grown with hydroponics technology within a week. The concept of hydroponic fodder production include putting one kilogram of grain into a hydroponic system and producing four to eight kilograms of fresh green sprouts, independent of weather and seasons. Development of this system has enabled the production of fresh forage from maize, oats, barley, wheat and other grains. Moreover, compared to conventional field cropping, hydroponics fodder needs only five per cent of space and two to three per cent of water (Al-Karaki, 2011). However, different factors like types of crops (Al-Karaki and Al-Hashimi, 2012), type of device used, light intensity and irrigation frequencies (El-Deeba *et al*., 2009), water quality, seed rate and seed

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quality (Naik *et al*., 2014) could influence the yield of hydroponic fodder. Thus, there is need to explore the possible use of maize grown under hydroponic system using a low cost hydroponic system. Hence, this study was carried out to evaluate the growth, yield, nutrient changes and cost of production of maize fodder grown under hydroponic system using a low cost device.

Materials and Methods

Hydroponics maize fodder production:

Hydroponic room

Size of the room used for installing the two hydroponic fodder making device was 16×13 ft and room was enclosed with green house net.

Low cost hydroponic fodder production device

The chambers (14ft× 5 ft × 6 ft) of hydroponic maize fodder producing unit, was built using stainless steel. The daily production capacity of each hydroponic maize fodder producing unit was 25 kg.

Water

Water was stored in a 300 liter capacity tank and the water used for irrigation was measured every day. Water fogging was done in every 2 hrs for 60 seconds with the use of automatic electronic controller circuit.

Seeds

Dry, sound and clean maize (*Zea mays* L.) seeds were procured from Haritha Agro Tech Ltd. Thrissur, Kerala. After 6 hours of soaking, maize seeds were transferred into a gunny bag and kept for 12 hours.

Trays

Two kg of germinating seeds were loaded on to plastic trays (4 ft × 2 ft). The plastic trays were having small pores at the bottom to facilities the drainage of water.

Cultivation of fodder

The hydroponic maize fodder was produced in nine days from planting to harvest by hydroponic technique.

Chemical compositions of maize seeds and hydroponic maize fodder were done by using of AOAC (2012) method. Growth and yield of the hydroponic fodder were measured and production cost of the hydroponic fodder was calculated. Data obtained on different parameters during the course of the experiment were subjected to statistical analysis (Snedecor and Cochran, 1994).

Results and Discussion

Growth of hydroponic fodder

The growth of hydroponic fodder (Table 1 and Fig. 1) was recorded in terms of sprout and root length up to nine days of sprouting and increased growth was observed during successive days of sprouting. The growth of maize fodder on ninth day of sprouting is given in Plate I. The sprout length was 0.55±0.05 cm on the first day and root length was 0.24±0.03 cm. The sprouting of maize grains was clear from second day and the root growth was clearly visible from third day onwards, as also noted by Naik *et al*. (2014). On the ninth day of harvest, sprout length was 26.00±1.90 cm and root length was 19.60±1.40 cm. On harvesting, the hydroponic maize fodder appeared like a mat and consisted of germinated seeds embedded with white root and green shoots. The growth of hydroponic fodder noted in the present study was similar to that recorded by Naik *et al*. (2015). Similarly, Gunasekaran *et al*. (2016) also found that the height of the hydroponic maize fodder was 27.00± 0.40 cm on ninth day of sprouting.

Yield of hydroponic fodder

The yield of hydroponic fodder (Table 1 and Fig. 2) was 1.29± 0.06 kg from one kg maize seed on the first day and the yield increased during first to nine days of sprouting. On ninth day, the total yield of the hydroponic maize fodder was 4.72±0.22 kg and the dry matter (DM) content of hydroponic maize fodder was 17.26 per cent (Table 1.). Present result on the yield of hydroponic fodder was in agreement with the earlier observations by Fazaeli *et al*. (2012), who noted 4.5 times more weight than the seed weight after six days of sprouting for hydroponic barley fodder. Similarly, Naik *et al.*

Table 1. Growth and yield of maize fodder* on different days of sprouting under hydroponic system

Day of sprouting	Growth		Yield of fodder (kg) from one kg of seed
	Sprout Length (cm)	Root Length (cm)	
1	0.55±0.05	0.24±0.03	1.29±0.06
2	2.50±0.17	1.81±0.15	1.41±0.12
3	4.40±0.90	4.05±0.45	1.95±0.13
4	6.35±1.06	8.15±1.15	2.76±0.15
5	10.25±1.05	14.75±1.75	3.22±0.14
6	14.00±1.90	15.60±1.30	3.83±0.17
7	20.25±1.75	18.75±2.25	4.19±0.21
8	25.05±1.65	19.12±1.71	4.39±0.18
9	26.00±1.90	19.60±1.40	4.72±0.22

* Average of six values with SE

(2014) also found an increase of 5.5 fold of hydroponic maize fodder yield on seventh day of cultivation than the seed weight with the DM content of 13.00 per cent. Gunasekaran *et al*. (2016) recorded a yield of 4.55 ± 0.08 kg of hydroponic maize fodder from one kg of seed.

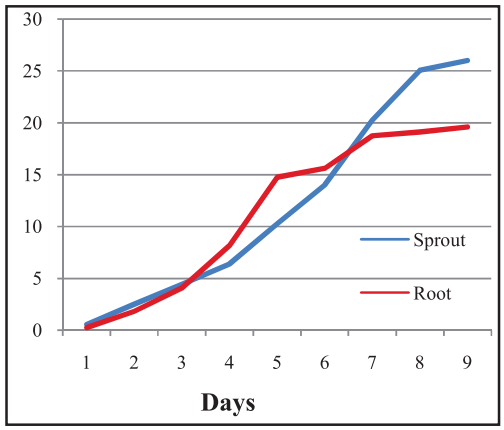

Fig. 1. Growth of hydroponic fodder on different days of sprouting, cm

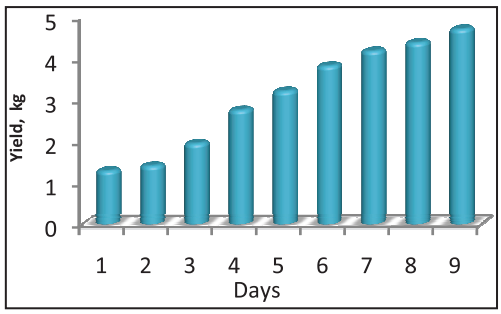

Fig. 2. Yield of hydroponic fodder on different days of sprouting, kg

Nutrient composition of hydroponic fodder maize

Chemical compositions of maize seed and ninth day harvested hydroponic fodder maize are presented in Table 2. The dry matter (DM) content of the maize seed was 90.33±0.10 per cent and it reduced to 17.26±0.55 per cent on ninth day of sprouting. Loss in DM content is due to the respiration process of the seed (Myers, 1974). The results of the present study is comparable with findings of Naik *et al*. (2014) and Gebremedhin (2015), who observed the DM content of the hydroponic maize fodder as 18.30 and 18.25 per cent at seventh and ninth day respectively. In the present study the crude protein level content of seed and hydroponic fodder was 8.12±0.15 and 13.01±0.04 per cent respectively and similarly 13.30 per cent of crude protein was reported by Naik *et al*, (2014). Increase in the crude protein content of hydroponic fodder is attributed to the absorption of nitrates from the carbohydrate reserves present in the grains (Morgan *et al*., 1992).

Ether extract (EE) content of the hydroponic maize fodder and seed was 3.47±0.01 and 2.08±0.01 per cent, respectively and the present results were correlated with findings of Naik *et al*. (2012) and Gunasekaran *et al*. (2016), who noted EE content of hydroponic maize fodder as 3.49 and 3.10 per cent respectively. Crude fibre (CF) content of hydroponic maize fodder was 8.72±0.11

Table 2. Nutrient composition of hydroponic fodder maize on ninth day of cultivation,%

Variety	DM	CP	EE	CF	NFE	ASH	AIA
Maize seed	90.33[a] ±0.10	8.12[a] ±0.15	2.08[a] ±0.01	2.74[a] ±0.01	85.71[a] ±0.15	1.35[a] ±0.04	0.029[a] ±0.00
Hydroponic fodder maize	17.26[b] ±0.25	13.01[b] ±0.04	3.47[b] ±0.01	8.72[b] ±0.11	71.89[b] ±0.11	2.95[b] ±0.02	0.53[b] ±0.02

a.b- means bearing superscripts within same column differ significantly (P<0.01)

per cent whereas 2.74 ±0.01 per cent CF was found in maize seed and similar results were also observed by Gebremedhin (2015) and Gunasekaran *et al*. (2016). The nitrogen free extract **(**NFE) content of maize seed and hydroponic maize fodder were 85.71±0.15 and 71.89±0.11 per cent respectively and the present result is comparable with the findings of Gebremedhin (2015) (71.89 and 68.47 per cent). However, Naik *et al*. (2012) found lower level of NFE (66.72 per cent). The total ash (TA) content observed in nine day grown hydroponic maize fodder was 2.95±0.02 per cent, which was higher than the TA content of seed (1.35±0.04 per cent) and similar, values were also reported by Gebremedhin (2015); however, it was lower than the value reported by Naik *et al*. (2012). The acid insoluble ash (AIA) content of maize seed was increased to its maximum level on ninth day (0.53 per cent) of sprouting compared to the AIA level of seed (0.029 per cent) and an agreement with the present results, Naik *et al*. (2012) and Gebremedhin (2015) also found comparable results (0.33 and 0.32 per cent respectively) of AIA of maize fodder grown under hydroponic system.

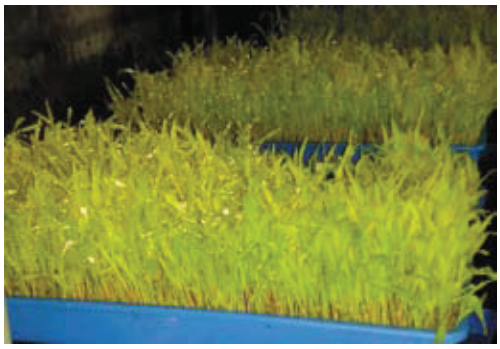

Fig. 3 . Growth of hydroponic fodder on ninth day of sprouting

Cost of production of hydroponic fodder

In this study, for production one kg hydroponic maize fodder was Rs. 5.26 and the cost of production is mainly depends on the seed cost. But production cost of Rs. 2-3 (home-grown seeds) to Rs. 3-3.5 (purchasing seeds) per kg hydroponic maize fodder is also reported (Naik *et al*., 2013).

Maize fodder was produced in nine days from planting to harvest by hydroponic technique and 4.72 kg yield was recorded at ninth day of cultivation. An increase in crude protein, ether extract, total ash and acid insoluble ash contents was observed in hydroponic maize fodder compared to maize seeds. Hydroponic technology can be used as an alternative to conventional field cropping.

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