Original Research

Productivity, Nutritive Value, Growth Rate, Biomass Yield and Economics of Different Hydroponic Green Fodders for Livestock

Rachel Jemimah, E.*, P. Tensingh Gnanaraj, T. Muthuramalingam, T. Devi[1] and C.Vennila[2]

Instructional Livestock Farm Complex, TANUVAS, Chennai, INDIA

[1]Department of Veterinary Preventive Medicine, Madras Veterinary College, TANUVAS, Chennai, INDIA
[2]Department of Agronomy, Madras Veterinary College, TANUVAS, Chennai, INDIA

***Corresponding author:** racheljemimah@gmail.com

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Abstract

The experiment was aimed to produce fodders by hydroponic method using different seeds commonly available in Tamil Nadu and to identify the most economical seed source for green fodder production by hydroponic method. Different seeds such as yellow maize, horse gram, sun hemp, jowar, ragi, cowpea, foxtail millet and bajra were selected for the study. Productivity, nutritive value, growth rate, biomass yield and economics of different hydroponic green fodders were studied. It was observed that sun hemp, horse gram and cowpea has significantly higher hydroponic fodder productivity per kg of seed. Leguminous type of fodders such as sun hemp, horse gram and cowpea has higher crude protein content than cereal type of fodders such as yellow maize, jowar, bajra, foxtail millet and ragi. Yellow maize has significantly higher root biomass (70 ± 0.52%) and low shoot biomass (30 ± 0.49 %) yield while sun hemp as significantly higher shoot biomass (80 ± 0.61%) and low root biomass (20 ± 0.63%) yield percentage. Yellow maize fodder has significantly lowest production cost (Rs. 3.20) than all the other hydroponic fodders. After analyzing the productivity, growth rate, nutritive value, biomass yield, cost of production and availability it was concluded that, yellow maize is the cost effective seed for green fodder production by hydroponic method in Tamil Nadu and horse gram and sun hemp fodder were found to be the most nutritive and high biomass yielding fodders.

Key words: Hydroponic Fodders, Nutritive Value, Growth Rate, Biomass Yield, Economics

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Introduction

Green fodder is the natural diet for livestock. Its production to meet the current demand has become the greatest challenge among the livestock farmers. Due to many reasons, green fodder production has been

facing a serious crisis and so the livestock productivity. Due to increasing intensive system of rearing livestock the need for green fodder is enormous. As the gap between the demand and supply of the green fodder for livestock becoming unconquerable, researchers and farmers are in search for an alternative fodder or fodder production method that would restore fodder and livestock production. Hydroponics is now emerging as an alternative technology to grow fodder for farm animals (Naik *et al*., 2011; Naik 2012a; Naik *et al.*, 2013a; Naik *et al*., 2013b; Naik and Singh, 2013; Naik, 2014; Naik and Singh, 2014; Naik *et al.*, 2015).

Materials and Methods

Production of Hydroponic Fodders

Green fodders were produced in environmentally controlled hydroponic green fodder machine of 1 ton capacity purchased from Emaar farm technik, Mumbai. Different seeds such as yellow maize, horse gram, sun hemp, jowar, ragi, cowpea, foxtail millet and bajra were selected for the study. Good quality seeds with less than 12% moisture were selected and weighed. Seeds were washed in tap water by stirring with wooden stick manually to remove chaffs and dirts. The seeds were then soaked in tap water for 20 hours. Water was then drained and the seeds were kept in gunny bags for 24 hours for germination. After germination, each type of seeds were weighed and placed onto 6 different trays and kept on the sprout section of hydroponic fodder machine. Each tray in the sprout section is provided with two drippers and one sprinkler which sprinkle water in every 3 hours for about 4 minutes. The trays were shifted to next rack daily. On the 5^{th} day the tray enters the growth cycle in which each tray is supplied with two sprinklers. After 8 days of total growth period in the machine the fodders were taken out, weighed and analyzed. Except yellow maize and jowar all the other seeds were grown only for 4 days in the machine due to spoilage of root after 5^{th} day of growth.

Proximate Analysis

Random samples were collected and proximate analysis of each hydroponic fodder and different stages of hydroponic maize fodder was done as per A.O.A.C. 2000.

Growth Rate

The root and shoot length of different hydroponic green fodders were measured using a meter scale daily during the entire growth period. The individual plant was carefully removed from the sprout mat for measurement. The root length was measured from the cuticle to the tip of the longest root segment and the shoot length was measured from the base of the hypocotyls to the tip of longest leaf.

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Biomass Yield

The shoot and root biomass of different hydroponic green fodders were quantified using a weighing balance. About 100 g of the fodders were taken. The shoots were separated from the roots and seeds by cutting at the base of the hypocotyls. The weight of root and shoot were quantified separately and the same was repeated for six different samples and the data were recorded.

Data Recording and Statistical Analysis

Data were recorded periodically; data were analysed statistically by one way - ANOVA using GraphPad prism software.

Result and Discussion

Productivity of Hydroponic Fodders

The word hydroponics has been derived from two Greek words hydro means 'water' and ponic means 'working'. Thus, fodder produced by growing plants in water or nutrient rich solution but without using any soil is known as hydroponics fodder or sprouted grains or sprouted fodder (Dung *et al.,* 2010a). Hydroponics is produced in greenhouses under controlled environment within a short period (Sneath and McIntosh, 2003). Hydroponics fodder is palatable and the germinated seeds embedded in the root system are also consumed along with the shoots of the plants without any nutrient wasting (Pandey and Pathak, 1991). Depending upon the type of grains, the hydroponics fodder looks like a mat of 11-30 cm height by the end of the germination period of about 8-days consisting of germinated seeds embedded in their white roots and green shoots (Snow *et al.,* 2008; Dung *et al.,* 2010b; Naik *et al.,* 2011; Naik *et al.,* 2014a). Fresh yield of 3.5-6.0 folds in 7-8 days with DM content of 10.3-18.5% in maize fodder has been reported (Naik I 2014a, Sneath and McIntosh, 2003). However 4.6 folds fresh yield of maize fodder was observed during our experiment. Production details of different hydroponic fodders in the form of seed and fodder production ratio was given in Table 1 and Fig. 1.

Table 1: Productivity of different types of hydroponic fodders (n=6)

S. No.	Type of Hydroponic Fodder	Seed : Fodder Production Ratio (kg)
1	Yellow maize	1.0 : 4.6^{ab}
2	Cowpea	1.0 : 6.6^{cb}
3	Horse gram	1.0 : 6.0^{b}
4	Ragi	1.0 : 3.5^{a}
5	Sun hemp	1.0 : 10.0^{d}
6	Bajra	1.0 : 3.0^{a}
7	Jowar	1.0 : 3.7^{a}
8	Foxtail millet	1.0 : 4.5^{a}

Means bearing same superscript in the same column do not differ significantly (P > 0.01);Means bearing ^{a,b} superscript in the same column differ significantly at (P < 0.05);Means bearing different superscript in the same column differ significantly at (P < 0.01)

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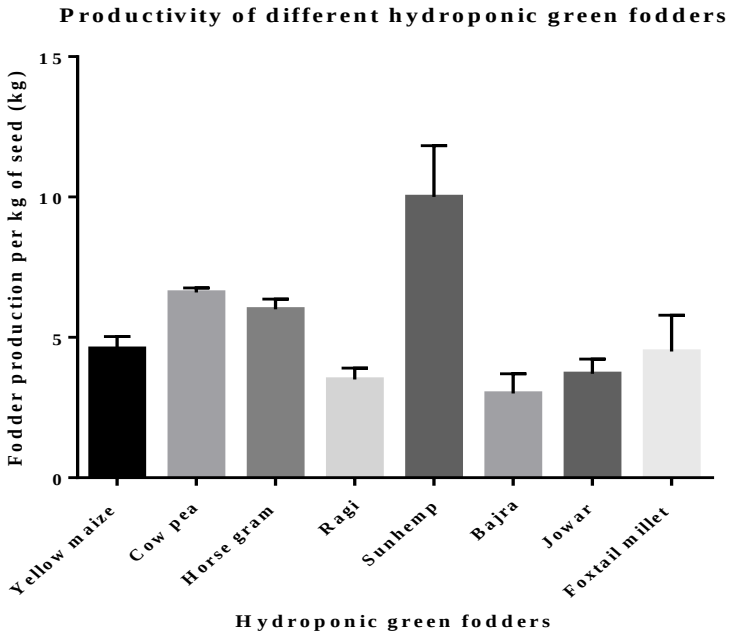

Fig. 1: Productivity of different hydroponic fodders

From the Table it is evident that sun hemp has significantly higher fodder productivity per kg i.e.10 kg of fodder per kg of seed when compared to other fodders and the descending order of productivity is as follows cowpea> horse gram>yellow maize>foxtail millet> jowar>ragi > bajra.

Nutritive Value of Hydroponic Fodders

All the hydroponic fodders have high level of moisture content than conventional green fodder. The crude protein content of sun hemp is higher (38.73%) than all the other fodders and the descending order of crude protein content is sun hemp fodder (38.73%) > horse gram fodder (30.26 %) > cow pea fodder (27.84%) >foxtail millet fodder (14.69 %) > jowar fodder (13.27%) > ragi fodder (10.62%) > maize fodder (10.55%) >bajra fodder (9.22 %) respectively; the crude fibre content descending order is jowar fodder (13.39%)>sun hemp fodder (13.11%)>horse gram fodder (13.00%)>foxtail millet fodder(12.11%)>ragi fodder (8.80%)>cow pea fodder (6.51%)>yellow maize fodder (5.51%) > bajra fodder (9.22%). Naik *et al.* (2015) reported a CP content of 13.57% in hydroponic maize fodder. Studies have not been reported in other types of hydroponic fodder listed in Table 2.

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Table 2: Nutritional composition of different hydroponic fodders

S. No.	Type of hydroponic fodder	Day of Growth	Moisture %	% Dry Matter Basis				
				CP	CF	EE	TA	NFE
1	Yellow maize	8	76.75^{b}	10.55^{a}	5.51^{a}	4.62^{c}	1.80^{a}	77.52^{g}
2	Horse gram	4	90.18^{e}	30.26^{d}	13.00^{c}	2.06^{ab}	5.43^{d}	49.25^{b}
3	Sun hemp	4	77.07^{b}	38.73^{e}	13.11^{c}	4.64^{c}	4.48^{c}	39.04^{a}
4	Cowpea	4	77.93^{c}	27.84^{c}	6.51^{a}	1.93^{a}	4.88^{cd}	58.84^{c}
5	Bajra	4	74.80^{a}	9.22^{a}	4.16^{a}	4.57^{c}	1.49^{a}	80.56^{h}
6	Ragi	4	87.86^{d}	10.62^{a}	8.80^{b}	2.52^{b}	2.95^{b}	75.11^{f}
7	Foxtail millet	4	75.08^{a}	14.69^{b}	12.11^{c}	5.38^{d}	3.59^{b}	64.23^{d}
8	Jowar	8	90.06^{e}	13.27^{b}	13.39^{c}	4.99^{cd}	2.98^{b}	65.37^{e}

Means bearing same superscript in the same column do not differ Significantly ($P > 0.01$);Means bearing ^{b,c} superscript in the 4th , 8th column differ significantly ($P < 0.05$);Means bearing different superscript in the same column differ significantly at ($P < 0.01$)

All the hydroponic fodders have higher CP, EE and NFE; and lower CF, TA than conventional green fodders. Naik *et al.* (2012b) also reported higher CP, EE and NFE; and lower CF and TA percentage in hydroponics maize fodder than the conventional maize fodder. The increase in CP content may be attributed to the loss in DM, particularly carbohydrates, through respiration during germination and thus longer sprouting time is responsible for greater losses in DM and increase in protein content. Besides, the absorption of nitrates facilitates the metabolism of nitrogenous compounds and thus increases the CP levels (Naik *et al.*, 2015). The nutrient contents of hydroponics fodder are superior to certain common non-leguminous fodders but comparable to leguminous fodders (Pandey and Pathak, 1991; Naik *et al.*, 2012a) in terms of available OM, CP, EE and NFE content. Nutritional composition of different stages of growth of hydroponic maize fodder was given below in Table 3.

Table 3: Nutritional composition of different stages of growth of hydroponic maize fodder

S. No.	Type of Hydroponic Fodder	Day of Growth	Moisture %	% Dry Matter Basis				
				CP	CF	EE	TA	NFE
1	Maize (Market source)	8	76.75^{i}	10.55^{e}	5.51^{e}	4.62^{f}	1.80^{bc}	77.52^{b}
2	Maize (Farm produced seed*)	8	82.79^{h}	17.55^{f}	7.81^{f}	5.29^{g}	3.49^{d}	65.86^{a}
3	Maize (Market source)	7	70.92^{g}	9.83^{d}	5.78^{e}	3.62^{ab}	1.98^{c}	78.79^{c}
4	Maize (Market source)	6	66.38^{f}	9.37^{bc}	4.54^{d}	3.56^{a}	1.94^{c}	80.59^{d}
5	Maize (Market source)	5	61.49e	9.41^{c}	3.40^{c}	4.23^{ed}	1.51^{ab}	81.45^{e}
6	Maize (Market source)	4	59.55^{d}	9.26^{bc}	2.93^{b}	3.83^{bc}	1.45^{ab}	82.53^{f}
7	Maize(Market source)	3	49.43^{c}	9.22^{b}	2.37^{a}	4.34^{e}	1.38^{a}	82.69^{g}
8	Maize (Market source)	2	37.31^{a}	8.79^{a}	2.21^{a}	4.10^{d}	1.36^{a}	83.54^{h}
9	Maize (Market source)	1	39.26^{b}	8.72^{a}	2.50^{ab}	3.92^{cd}	1.43^{ab}	83.43^{h}

Means bearing same superscript in the same column do not differ Significantly ($P > 0.01$); Means bearing $^{b, c}$ superscript in the 4th and 5th column, ^{e,d} superscript in the 7th column and ^{g,f} superscript in the 9th column differ significantly ($P < 0.05$); Means bearing different superscript in the same column differ significantly at ($P < 0.01$)

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**The high CP in the farm produced maize seeds is attributed to dung well irrigation of the maize crops during their growth period. Maize seeds both farm produced and market source were utilized for the growth of hydroponic maize fodder within a month after harvest.*

From the Table it is evident that the nutritional content of the hydroponic maize fodder gradually increased across the 8 days of growth from 8.72% to 10.55%. The variation in CP from 7 8.60- 13.90% across 7 days of growth in yellow maize fodder was reported by Naik *et al.* (2015).

Growth Rate

Comparative growth rate of all the fodders for every other day given in Table 4 .Significant difference in growth was noticed between different hydroponic fodders at the same day of growth.

Table 4: Comparison of growth rate at same day of growth between different hydroponic fodders

Growth Rate		Hydroponic Fodders			
		Yellow Maize	**Horse Gram**	**Sun Hemp**	**Jowar**
Root length (cm)	Day 1	0.6 ± 0.21^{12}	1.5 ± 0.22^{2}	-	0.1 ± 0.22^{1}
	Day 2	3.3 ± 0.18^{2}	3.1 ± 0.35^{2}	2.4 ± 0.12^{1}	4.1 ± 0.32^{3}
	Day 3	10.1 ± 0.22^{3}	4.9 ± 0.19^{1}	5.8 ± 0.26^{1}	8.5 ± 0.39^{2}
	Day 4	12.0 ± 0.15^{3}	8.3 ± 0.34^{1}	10.2 ± 0.25^{2}	11.1 ± 0.44^{23}
	Day 5	13.1 ± 0.31^{1}	-	-	14.9 ± 0.36^{2}
	Day 6	13.9 ± 0.18^{1}	-	-	16.6 ± 0.38^{2}
	Day 7	14.5 ± 0.33^{1}	-	-	17.9 ± 0.22^{2}
	Day 8	17.5 ± 0.26^{1}	-	-	20.3 ± 0.35^{2}
Shoot length (cm)	Day 1	1.3 ± 0.15^{2}	-	1.1 ± 0.37^{2}	0.2 ± 0.43^{1}
	Day 2	2.2 ± 0.16^{1}	-	5.3 ± 0.26^{2}	1.9 ± 0.26^{1}
	Day 3	9.9 ± 0.24^{2}	8.9 ± 0.52^{2}	12.5 ± 0.183^{3}	6.9 ± 0.37^{1}
	Day 4	14.5 ± 0.36^{3}	11.5 ± 0.48^{2}	16.1 ± 0.26^{4}	8.8 ± 0.19^{1}
	Day 5	22.3 ± 0.27^{2}	-	-	11.6 ± 0.28^{1}
	Day 6	25.2 ± 0.19^{2}	-	-	15.1 ± 0.31^{1}
	Day 7	27.3 ± 0.27^{2}	-	-	19.5 ± 0.46^{1}
	Day 8	36.0 ± 0.42^{2}	-	-	20.1 ± 0.28^{1}
No. of leaves per plant	Day 1	-	-	-	-
	Day 2	-	-	21	11
	Day 3	21	21	21	11
	Day 4	21	21	21	21
	Day 5	31	0	0	21
	Day 6	31	0	0	21
	Day 7	31	0	0	21
	Day 8	41	0	0	21

Means bearing same superscript in the same row do not differ Significantly ($P > 0.01$);Means bearing ^{1,2} superscript in the 4th 6th 10th 11th row, ^{3,4} superscript in the 14th differ significantly ($P < 0.05$);Means bearing different superscript in the same row differ significantly at ($P < 0.01$)

Growth rate of hydroponic fodders such as yellow maize fodder, horse gram fodder, sun hemp fodder and jowar fodder were studied. Significant growth rate was noticed each day than the previous day in all type

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of hydroponic fodders. In cereal type of fodders such as yellow maize and jowar the root length was significantly longer in jowar fodder (20.3 ± 0.35 cm) while the shoot length is significantly longer in yellow maize fodder (36.0 ± 0.42 cm). In leguminous type of fodders such as horse gram and sun hemp, both shoot and root length are significantly longer in sun hemp fodder (16.1 ± 0.26 cm,10.2 ± 0.25 cm) than horse gram fodder (11.5 ± 0.48 cm ,8.3 ± 0.34 cm). There was no significant difference in no. of leaves per plant during each day of growth in all the type of hydroponic fodders. 2 - 4 leaves per plant was noticed in yellow maize fodder however only 2 leaves per plant was noticed in jowar, horse gram and sun hemp fodder.

Biomass Yield

The biomass yield of yellow maize fodder, jowar fodder, horse gram fodder and sun hemp fodder were studied and tabulated in Table 5 and shown in Fig. 2. Significantly different root and shoot biomass yield percentage was noticed between cereal type of fodder and leguminous type of fodder.

Table 5: Biomass yield of different hydroponic fodder (n = 6) (Mean ± SE)

S. No.	Type of Hydroponic Fodder	Root Biomass (%)	Shoot Biomass (%)
1.	Yellow maize	70 ± 0.52^{c}	30 ± 0.49^{a}
2.	Jowar	60 ± 0.39^{bc}	40 ± 0.38^{ab}
3.	Horse gram	40 ± 0.48^{ab}	60 ± 0.52^{bc}
4.	Sun hemp	20 ± 0.63^{a}	80 ± 0.61^{c}

Means bearing same superscript in the same column do not differ Significantly (P > 0.01); Means bearing ^{a,c} superscript in the 3rd and 4th column differ significantly (P < 0.01)

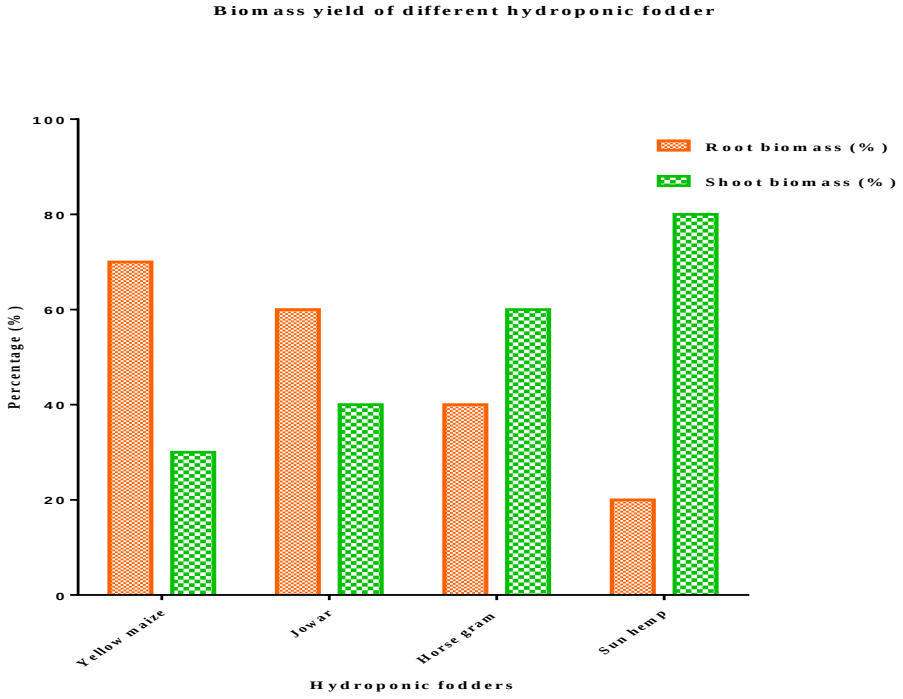

Fig. 2: Biomass yields of different hydroponic fodders

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The biomass yield of yellow maize fodder, jowar fodder, horse gram fodder and sun hemp fodder were studied. From the table it is evident that the root biomass was higher cereal type of fodder i.e. in yellow maize fodder (70 ± 0.52%) and jowar fodder (60 ± 0.39%) and the shoot biomass was higher in leguminous type of fodder i.e. sun hemp fodder (80 ± 0.61) and horse gram fodder (60 ± 0.52%). Yellow maize has significantly low shoot biomass yield (30 ± 0.49%) while sun hemp as significantly higher shoot biomass yield (80 ± 0.61%) percentage.

Economics

The cost of production of 1 kg of different hydroponic fodders was given in the Table 6 and Fig. 3.

Table 6: Cost of production of different hydroponic fodders

S. No.	Type of Hydroponic Fodder	Cost (Rs.)
1	Yellow maize	3.20[a]
2	Horse gram	5.60[c]
3	Sun hemp	4.10[b]
4	Cowpea	10.90[g]
5	Bajra	7.43[d]
6	Ragi	8.32[e]
7	Foxtail millet	9.32[f]
8	Jowar	7.90[de]

Means bearing same superscript in the same column do not differ Significantly (P > 0.01); Means bearing [a,b] superscript, [d,e] superscript and [e,f] superscript in the differ significantly (P < 0.05);Means bearing different superscript in the same column differ significantly at (P < 0.01)

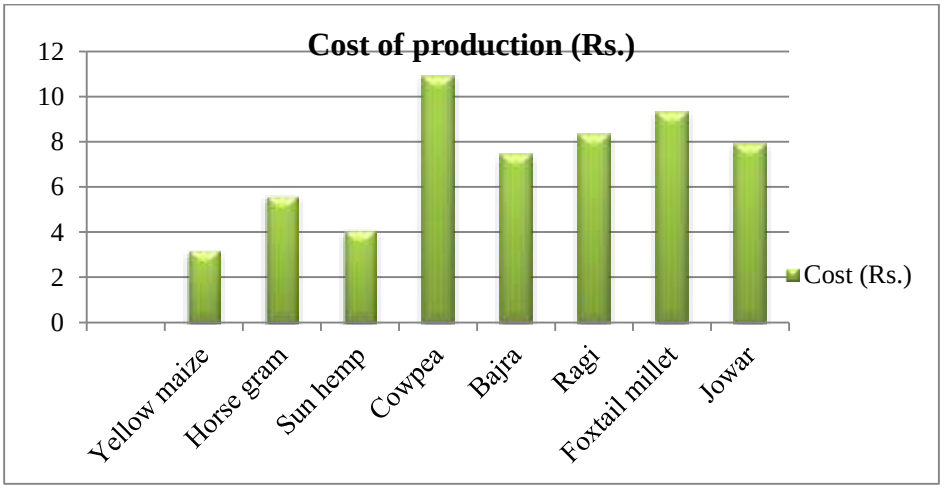

Fig. 3: Cost of production of different hydroponic fodders

From the Table it is evident that, yellow maize is the economical fodder of choice to grow by hydroponic system in Tamil Nadu. Naik *et al.* (2015) also reported that the maize is the choice of grain to produce green fodder by hydroponic system in India. In Goa condition with hi-tech greenhouse, the cost of production of

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fresh hydroponics maize fodder is about Rs 4.-4.50/- per kg (Naik *et al.*, 2012a) however the cost of production of per kg hydroponic maize fodder is Rs. 3.20/- in Tamil Nadu condition. Thus yellow maize is the suitable seed of choice for hydroponic fodder production.

Conclusion

Hydroponic method has made a greatest impact in the fodder production system. Maize has been found to be most suitable seed of choice for economical fodder production through hydroponic system in Tamil Nadu. Horse gram and sun hemp also have given promising results by their high crude protein content. However further research is needed to study their application as a fodder for livestock. Growth rate of hydroponic fodders such as yellow maize fodder, horse gram fodder, sun hemp fodder and jowar fodder were studied. Significant growth rate was noticed each day than the previous day in all type of hydroponic fodders. Significantly different root and shoot biomass yield percentage was noticed between cereal type of fodder and leguminous type of fodder.

References

1. Dung D D, Godwin, I R and Nolan J V. 2010a. Nutrient content and *in sacco* degradation of hydroponic barley sprouts grown using nutrient solution or tap water. *J. Anim. Vet. Adv.* 9 (18): 2432-2436.
2. Dung D D, Godwin I R and Nolan J V. 2010b. Nutrient content and *in sacco* digestibility of barley grain and sprouted barley. *J. Anim. Vet. Adv*. 9 (19): 2485-2492.
3. Naik P K, Dhuri R B and Singh N P. 2011.Technology for production and feeding of hydroponics green fodder. Extension Folder No. 45/ 2011, ICAR Research Complex for Goa, Goa.
4. Naik P K. 2012. Hydroponics technology for fodder production. ICAR News. 18: 4.
5. Naik, P.K., Dhuri, R.B., Swain, B.K. and Singh, N.P. 2012a.Nutrient changes with the growth of hydroponics fodder maize. *Indian J. Anim. Nutr*. 29: 161-163.
6. Naik P K, Dhuri R B , Swain B K and Singh N P 2012b. Cost of production of hydroponics fodder maize. In: Proc. of 8th Biennial Animal Nutrition Association Conference on 'Animal Nutrition Research Strategies for Food Security', November 28-30, 2012, Bikaner, Rajasthan, India, p.12.
7. Naik P K , Dhuri R B , Karunakaran M and Swain B K and Singh N P. 2013a. Hydroponics technology for green fodder production. *Indian Dairyman.* 65: 54-58.
8. Naik P K , Gaikwad S P , Gupta M J , Dhuri R B , Dhumal G M and Singh N P. 2013b. Low cost devices for hydroponics fodder production. *Indian Dairyman. 65:* 68-72.
9. Naik P K and Singh N P. 2013. Hydroponics fodder production: an alternative technology for sustainable livestock production against impeding climate change. In: compendium of Model Training Course I held during November 18-25, 2013. Southern Regional Station, National Dairy Research Institute, Adugodi, Bengaluru, India, Pp. 70-75.
10. Naik P K and Singh N P. 2014. Production and feeding of hydroponics green fodder. *Indian Farming*. 64 (6): 42- 44.
11. Naik P K. 2014.Hydroponics green fodder for dairy animals. In: Recent Advances in Animal Nutrition (M.P.S. Bakshi and M. Wadhwa; Eds). Satish Serial publishing House, 403, Express Tower, Commercial Complex, Azadpur, Delhi-110 033, India.
12. Naik P K , Dhuri R B, Karunakaran M , Swain B K and Singh N P. 2014a. Effect of feeding hydroponics maizefodder on digestibility of nutrients and milk production in lactating cows. *Indian J. Anim. Sci.* 84(8): 880-883.

 DOI 10.5455/ijlr.20171013104959

13. Naik P K , Swain B K and Singh N P 2015. Production and Utilisation of Hydroponics Fodder. *Indian J. Anim. Nutr*. 2015. 32 (1): 1-9.
14. Pandey H N and Pathak N N. 1991. Nutritional evaluation of artificially grown barley fodder in lactating crossbred cows. *Indian J. Anim. Nutr*. 8 (1): 77-78.
15. Sneath R and Mclntosh F. 2003. Review of hydroponic fodder production for beef cattle. Queensland Government, Department of Primary Industries, Dalby, Queensland.
16. Snow A M, Ghaly A E and Snow A. 2008. A comparative assessment of hydroponically grown cereal crops for the purification of aquaculture waste water and the production of fish feed. *Am. J. Agric. Biol. Sci*. 3 (1): 364-378.

DOI 10.5455/ijlr.20171013104959