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Effect of different nutrient solutions on the biomass yield and nutritive value of low cost hydroponic fodder maize

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Availability of quality green fodder has always been a challenge to the farmers. The pasture land has declined over the past decades due to various reasons and the green fodder deficit in India is reported to be 24.81% (Vision 2030). For a sustainable dairy farming, quality green fodder should be fed regularly to the dairy animals (Naik *et al*. 2014). Conventional growing of fodder crops in soil involves large land area, more manpower and huge quantity of water. Moreover, in metropolitan/sub urban areas, land is not available for fodder cultivation. Of late, another serious problem experienced is manpower availability for conventional open field agriculture (Butler *et al.* 2006).

To overcome these problems, the alternative technology to increase green fodder production by vertical farming is through "hydroponic fodder production" which requires less land, water and manpower. This system helps to overcome the challenges of climatic change and also helps in efficient utilization of natural resources and mitigating malnutrition (Butler *et al.* 2006). The effect of different nutrient solutions on hydroponic fodder growth in a low cost unit was studied in fodder maize seeds.

The seeds were soaked in water for 16 h and then kept for sprouting process in a gunny bag for 32 h. Crates loaded with the sprouted grains were irrigated with different solutions manually using sprayer, five times a day. The different nutrient solutions were water, 2.5% biogas slurry, 10% diluted cow urine, 0.1% urea and 10% vermiwash solution with 5 replicates in each. The growth parameter for fodder maize after 8 days of sprouting was recorded and the fodder was analysed for its proximate principles as per AOAC (2001).

The biomass yield of hydroponic fodder maize was higher with water as a nutrient solution (4.55±0.08 kg/kg of seed). Naik *et al.* (2013) reported that fresh matter yield of 5 to 6 folds and dry matter content up to 18%. The biomass yield in 0.1% urea and 10% diluted cow urine was significantly lower compared to other treatments; however, within water, vermiwash and biogas slurry treatments there was no significant difference (Table 1). The lower biomass in 0.1% urea and 10% diluted cow urine could be due to

Table 1. Effect of different nutrient solutions on the mean biomass yield, fodder height (cm) and dry matter yield (%) of hydroponic maize fodder

Parameter / Treatment	Biomass yield (kg/kg of seed)	Fodder height (cm)	Dry matter (%)
Control (water)	4.55^{c}±0.08	27.0^{c}±0.40	17.7^{a}±0.40
10% vermiwash	4.49^{c}±0.06	29.0^{d}±0.57	17.9^{a}±0.34
0.1% urea	3.30^{a}±0.17	22.5^{a}±0.50	21.8^{b}±0.15
10% diluted cow urine	3.69^{b}±0.12	24.0^{ab}±0.70	21.5^{b}±0.50
2.5% biogas slurry	4.18^{c}±0.05	24.6^{b}±0.40	21.2^{b}±0.25

Means with different superscripts within a coloum differ significantly (P<0.05).

Table 2. Nutrient composition of hydroponic fodder (maize) grown in different nutrient solutions (per cent DMB)

Nutrient*	Control (water)	10% vermiwash	0.1% urea	10% diluted urine	2.5% biogas slurry
Crude protein	13.38±0.14	13.06±0.06	14.89±0.17	13.52±0.23	12.53±0.10
Crude fibre	10.86±0.30	9.03±0.05	9.16±0.05	8.88±0.13	8.82±0.10
Ether extract	2.82±0.10	2.66±0.05	2.69±0.08	2.49±0.09	2.76±0.06
Total ash	2.13±0.03	2.20±0.09	1.63±0.03	2.04±0.04	1.81±0.05
NFE	70.63±0.37	70.84±2.05	70.82±0.62	72.00±0.56	73.09±0.76

Mean of 5 samples, *nonsignificant.

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Table 3. Comparison of beta carotene levels in maize seed, and hydroponic fodder maize

Samples	Beta carotene content (mg/100g)
Maize seed	132.13±1.43
Hydroponic fodder maize	251.87±1.10

acidic and alkaline nature of nutrient solution respectively.

Though statistically nonsignificant, highest crude protein in fodder produced was observed when 0.1% urea used as nutrient solution (Table 2). The hydroponic fodder grown in water as nutrient solution is preferred over other treatments due to the higher biomass yield (4.55±0.08 kg/kg of seed). Similar nutrient profile of hydroponic fodder maize viz. crude protein (13.30%), ether extract (3.27%) and NFE (75.32%) levels was reported by Naik *et al*. (2014).

The beta carotene content of hydroponic fodder maize was higher by 47% compared to that of maize seed and will be useful in amelioration of fertility in cattle, sheep and goats (Table 3).

It can be concluded that hydroponic fodder maize can be produced without any additional nutrient supplementation for feeding animals.

SUMMARY

The effect of different nutrient solutions on hydroponic maize fodder growth in a low cost unit was studied. The different nutrient solutions were water, 2.5% biogas slurry, 10% diluted cow urine, 0.1% urea and 10% vermiwash solution. The growth parameter for fodder maize after eight days of sprouting was recorded and the fodder was analysed for its proximate principles. The biomass yield of hydroponic fodder maize was higher with water as a nutrient solution 4.55±0.08 kg/kg of seed. The biomass yield in 0.1% urea and 10% diluted cow urine was significantly lower compared to other treatments. Highest crude protein in maize fodder produced was observed when 0.1% urea was nutrient solution. The beta carotene content of hydroponic fodder maize was higher by 47% compared to that of maize seed.

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