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Investigating the impact of varying seed rates on the composition and production of hydroponic fodder in Chitwan

Abstract: The 2019–20 season saw the National Cattle Research Program's Rampur Chitwan farm host the research. In hydroponic fodder production, four different seed rates of 4, 5, 6, and 7 kg of maize were used. At a seed rate of 7 kg/m², the green matter yield per m² was 28.09±0.55, followed by 6,5,4 kg at 23,97±0.13, 20.68±0.27, and 16.46±0.25 kg, respectively. In varied seed rates of 7, 6, 4, and 5, the root and seed weights (as a percentage of total yield) were 69.00±0.38, 68.56±0.57, 68.45±0.76, and 68.22±0.45, respectively. The research found that different seed rates resulted in significantly different green matter production per kg seed (4.11, 4.13, 3.99 and 4.01 kg) and dry matter yield per kg seed (0.83, 0.84, 0.86 and 0.90 kg). Hydroponic feedstocks produced at varying seed rates did not differ significantly in terms of their composition (roots with germinated seed, leaves and plants), moisture, CP, EE, CF, NFE, and TA. According to the results, the most water-efficient way to grow hydroponically green fodder is using maize at a density of 7 kg/m².

Keywords: hydroponic, seed, maize, and feed.

INTRODUCTION

Hydroponics is a way to grow seedlings for feed that don't need soil. They typically take around seven or eight days to mature. Plants in this system get no other inputs except water and fertilizer. For optimal reproductive and productive performances, green fodder must be included in the dairy diet. Major obstacles to sustainable dairy farming and fodder production include a lack of available green fodder throughout the year and an inadequate supply of land, fertilizer, irrigation, and manpower. Because of these limitations in traditional feed production

Thus, hydroponics is emerging as a cutting-edge agricultural technology that meets the nutritional needs of cattle (Girma and Gebremariam, 2014). A variety of forage crops may be grown in a clean, chemical-free environment using the hydroponic method, which allows for the production of green fodder (Jensen and malter 1995, Hasmi 2008, karaki and momami 2011). According to Tudor et al. (2003), Cuddeford (2003), and Karaki (2011), this method is well recognized for its ability to produce a large amount of feed continuously with little water use. Milking heifers and cows fed hydrophonic fodders had higher conception rates, higher milk fat levels, and higher milk outputs in herds when preferred feed was scarce or of low quality (Shipard, 2005).

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Consequently, the scarcity of feed for our animals is becoming worse by the day and has only now become a major issue for cattle raising. Cultivating hydroponic fodder in a tiny home within a short period is the finest technique to handle all these obstacles. Grain that has been hydroponically sprouted is not so much grown as it is transformed in quality and dry matter weight via the addition of substantial time and resources.Gothic (2005). An indoor hydroponic fodder production unit (greenhouse) with 140 metal trays measuring 45 cm x 102 cm and featuring tiny holes for water drainage was set up at NCRP in the previous fiscal year (2018/19). Transparent fiber sheet serves as both the side wall and top of the hydroponic unit, which is equipped with motor-regulated water sprayers and exhaust fans. At a seed rate of 7 kg/m2, this device can produce 260 kg of new hydroponic maize feed each day, provided that 20 trays are replaced daily. In comparison to growing them in the wild, growing green fodders in a hydroponic system consumes much less water. Researching the effects of varying seed rates on the composition and yield of hydroponically grown green fodder was the driving force for this investigation.

Materials and methods

A study was carried out at NCRP to assess the effect of seed rate on green matter and dry matter yield of hydroponic maize fodder (HMF) in February, 2020. Accordingly, an experimental trial was conducted using Arun-4 variety of maize with four different seed rates (4 kg, 5 kg, 6 kg and 7 kg/m^2) replicated six times. The required amount of seed per tray (according to different seed rates) was soaked overnight on separate plastic pots. On the next morning the water from soaked seeds were drained and uniformly placed on the trays. After that water was sprayed to the seed regularly (4-5 times per day). No any nutrients and chemicals were supplied to the seeds. On the 11th day hydroponic maize fodder was harvested from each tray and weighed. 500 gm sample of whole hydroponic maize fodder was taken for dry matter estimation. After harvesting the leaves along with stem and roots and germinated seeds were separated manually and weighed.

Seed collection, preparation and germination

Seed of maize was collected from local market at Narayanghat Chitwan in a reasonable prize. These seed were sundried in a few time to turn its DM at 12-14%.This dry matter% is better for storage and germination. After weighing the seeds were washing with freshwater in 2 times in a bucket. After then soaking the seeds into fresh water for 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 maize seeds were placing into gunny bag. Here stayed 24 hours for proper germination.24 hour's later germination were occurred and then seeds were transplanted on trays. At that time germination occurred properly then seeds were placing in the trays through spreading. Water was given timely. At that time germination occurred properly then seeds were placing in the trays through spreading.

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 require amount in production.

Harvesting:

After 8, 9 and 10 days of transplantation the samples of fodders were collected for bio mass yield. Finally, after 10 days hydro-phonic fodder were harvested and total production was calculated on DM basis.

Recording of Data

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

Composition Analysis

After harvesting the hydroponics maize fodder daily, the roots along with germinated seeds and leaves were separated manually for proximate analysis (AOAC 2000).

Data Analysis

Data were recorded in MS-Excel 2007 and analysis of variance was done by using SPSS version16. One-way NOVA was applied and comparison between means was done by LSD at 0.05 level of significance.

Fig 1: Hydroponic maize production in NCRP, Rampur

Results and Discussions

The production parameters of hydroponic maize fodder with different seed rates are presented below in table 1. The green matter yield (total fresh yield) per m^2 of hydroponic maize fodder was found significantly increased ($p<0.001$) with increasing seed rates. The other parameters; root & seed weight (as % of total yield), leaf & stem weight (as % of total yield), plant height, GM yield per kg seed and DM yield per kg seed were statistically non- significant ($p>0.05$). The root and germinated seed yield (as % of total yield) ranged from 68.22 to 69.00. This result is similar to the findings by (Naik *et al.*, 2017) who reported the root yield 68.52%, 67.51%, 68.41%, 68.32% with seed rates 3.8, 5.1, 6.2, 7.6 kg/m^2 respectively. Similarly, the leaf and stem weight (as % of total yield) of present findings were also supported by those authors. The green matter yield per kg seed in this study was (4.11, 4.13, 3.99 and 4.01 kg) and dry matter yield per kg seed (0.83, 0.84, 0.86 and 0.90 kg) with seed rates 4, 5, 6, 7 kg m^2 respectively. Naik *et al.*, 2017 also got non-significant result on green matter and dry matter yield per kg seed. The authors obtained dry matter yield per kg seed in a range from 0.64 to 0.68 kg with above mentioned seed rates. However, the dry matter yield per kg seed in present findings was higher (0.83 - 0.90 kg) than that reported by Naik *et al.*, 2017 which might be due to delay in harvesting the HMF (on 11^{th} day) in this study.

Table 1: Production performance of hydroponic maize fodder with different seed rates at NCRP, Rampur

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Parameters	Seed rate, kg/m^2*				P value
	4	5	6	7	
Green matter yield per m^2 (kg)	16.46±0.25	20.68±0.27	23.97±0.13	28.09±0.55	0.000
Root and seed weight (% of total yield)	68.45±0.76	68.22±0.45	68.56±0.57	69.00±0.38	0.794
Leaf and stem weight (% of total yield)	31.55±0.80	31.64±0.46	31.45±0.57	30.98±0.38	0.856
Plant height (cm)	17.73±0.49	17.9±0.38	19.11±0.52	17.88±0.39	0.145
Green matter yield per kg seed (kg)	4.12±0.06	4.13±0.05	3.99±0.02	4.01±0.06	0.256
Dry matter yield per kg seed (kg)	0.83±0.03	0.84±0.04	0.86±0.03	0.90±0.02	0.421

*Values are (Mean±SE)

The green biomass yield of hydroponic maize fodder per square meter is presented below in table 2. The green biomass yield (fresh yield) per m^2 was statistically significant for different seed rates ($p<0.001$). Green matter yield per m^2 was highest in 7 kg/m^2 seed rate (28.09±0.55 kg) and lowest in 4 kg/m^2 seed rate (16.46±0.25). On one study on Rampur Composite variety of maize, 11.10 kg green matter per m^2 was produced with seed rate of 3 kg/m^2 on 8th day harvesting (NCRP, 2019).

Table 2: Green matter yield of hydroponic maize fodder per m^2 with different seed rates at NCRP, Rampur

Seed rate, kg/m^2	Green matter yield per square meter (kg)*
4	16.46±0.25^{a**}
5	20.68±0.27^{b}
6	23.97±0.13^{c}
7	28.09±0.55^{d}

*Values are (Mean±SE). ** Values with different superscripts differ significantly ($p<0.001$)

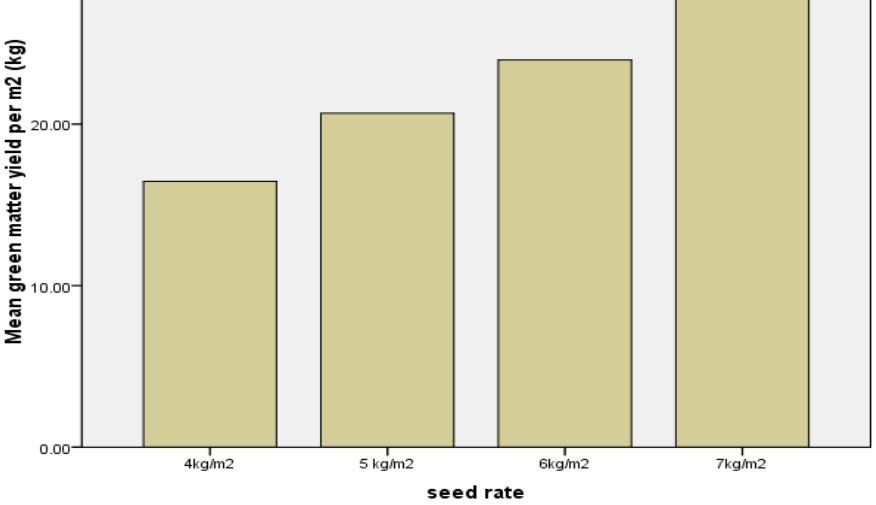

Fig 2: Mean green matter yield per m^2 in different seed rate

Table 3: Proximate analysis of parts of hydroponics maize fodder in different seed rate

Features	Hydroponic Maize Fodder			
Seed rate(kg) *	4	5	6	7
Root with germinated seed				
Moisture	14.77	15.23	15.43	15.53
CP	10.29	10.30	10.30	10.29
EE	3.00	2.99	3.02	3.00
CF	9.79	9.80	9.79	9.82
NFE	75.37	74.98	75.27	75.19
TA	1.55	1.60	1.54	1.55
Leaves				
Moisture	6.84	6.85	6.80	6.85
CP	22.30	22.12	22.35	22.31
EE	2.94	2.91	2.95	2.91
CF	17.45	17.52	17.43	17.49
NFE	55.87	55.82	55.79	55.80
TA	3.86	3.80	3.85	3.83
Plants				
Moisture	12.60	12.58	12.63	12.70
CP	12.41	12.20	12.39	12.45
EE	2.60	2.67	2.68	2.61
CF	12.90	12.95	12.98	13.07
NFE	70.35	70.50	70.45	70.52
TA	2.16	2.18	2.20	2.15

*No significant (P<0.05).

Results on table 3 showed that in composition of root with germinated seed, leaves and plant in different seed rate for hydroponic fodder production there was no significant difference in term of moisture, crude protein, ether extract, crude fiber, nitrogen free extract and total ash. The moisture content was highest in the roots

(15.53%) and lowest in the leaves (6.80%) of the hydroponic maize production. The CP, CF and TA contents (%) were highest in the leaves (22.35, 17.52 and 3.86) and lowest in the roots (10.31, 9.79 and 1.60). The EE content of the leaves (2.95%) was similar with the roots (3.02%) and plants (2.20%). The NFE content (%) of the root (75.37%) was differ with leaves (55.87%) and plants (70.52).In previously studies (Naik et al. 2012, Naik et al. 2014) reported 18.30% DM, 13.30–13.57% CP, 3.27– 3.49% EE, 6.37–14.07% CF, 66.72–75.32%
NFE, 1.75– 3.84% TA in the hydroponic maize fodder, which is similar to the nutrient content of

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the hydroponic maize fodder plant of the present study. This study showed that the seed rate had no effect on the proximate constituents of different portions i.e. roots with germinated seeds, leaves and plants of the hydroponic maize production. The seed rate of 7.6 kg/m2 can be recommended for the production of hydroponics maize fodder for optimal output and all parts of the hydroponics maize fodder are nutritious.

Conclusions:

This result suggests that under the constraints of land availability with objectives of increasing forage production the seed rate 7 kg/m^2 is suitable for higher hydroponic maize fodder production per unit area. However, further study will be needed experimenting higher seed rates (8, 9, 10 kg/m^2) with nutrient analysis of fodder to have precise conclusion and recommendations.

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