International Journal of Veterinary Science and Agriculture Research
Volume 3 Issue 1, January-February 2021
ISSN: 2582-4112 Available at www.ijvsar.com

Study on effects of different seed rates in hydroponic fodder production and its composition in Chitwan

Sagar Paudel, Bodh Raj Baral, Kapur Bhusal ,Shiva Hari Ghimere, Yagya Raj Pandeya, Devi Prasad Adhikari , and Pratik Hamal

National Cattle Research Program Rampur, Chitwan, Nepal

For Correspondence

Sagar Paudel

National Cattle Research Program Rampur, Chitwan, Nepal

sagarnarc@gmail.com

Abstract: *This study was carried out at National Cattle Research Program Rampur Chitwan farm in 2019-20. There was four different seed rate 4, 5, 6 and 7 kg rate of maize in hydroponic fodder production. The green matter yield per m^2 was high (28.09±0.55) in 7kg/per meter square seed rate followed by 6,5,4 kg (23.97±0.13, 20.68±0.27 and 16.46±0.25) respectively . There were no significant differences in root and seed weight (% of total yield) in different seed rate7, 6, 4 and 5 were 69.00±0.38, 68.56±0.57, 68.45±0.76 and 68.22±0.45 respectively There was significant differences in 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. There was no significant difference in composition (root with germinated seed, leaves and plants) Moisture, CP, EE, CF, NFE and TA of hydroponic fodder in different seed rate production. It can be concluded from this study that maize with 7 kg per meter square can be considered the best choice for production of hydroponic green fodder with less water consumption.*

Keywords: *maize, fodder, hydroponic, seed.*

I. INTRODUCTION

Hydroponics fodder production is the method of producing 7-8 days fodder seedlings without soil. In this system only moisture and nutrients are provided to the growing plants. Green fodder is an essential component of dairy ration for optimum productive and reproductive performances. However, the scarcity of adequate land, fertilizer, irrigation and labor along with unavailability of green fodder round the year are major constraints for fodder production and sustainable dairy farming. Due to these constraints in conventional fodder production

system, hydroponics is coming as one of the progressive technologies in agriculture which satisfies the nutrient demand of livestock (Girma and Gebremariam, 2014). Hydroponic technique can be used for green fodder production of many forage crops in a hygienic environment free of chemicals like insecticides, herbicides, fungicides, and artificial growth promoters (Jensen and malter 1995, Hasmi 2008, karaki and momami 2011). It is a well-known technique for high fodder yield, year round production and least water consumption (Tudor et al 2003, Cuddeford 2003; Karaki 2011). Increasing milk yields in herds with a very low quantity & quality of preference 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). 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. 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,Tudor (2005). In the previous fiscal year (2018/19) a small hydroponic fodder production unit (green house) was established at NCRP having 140 metallic trays having small holes for water drainage (tray size 45 cm x 102 cm). The side wall and roof of hydroponic unit is made up of transparent fiber sheet and facilitated with motor regulated water sprayers and exhaust fans. With a daily arrangement of 20 trays replacement, this unit has daily production capacity of 260 kg fresh hydroponic maize fodder at 7 kg/m^2 seed rate. Producing green fodders under hydroponic conditions is a highly efficient process in terms of water saving when compared to field production of green fodders. The objective of this study was to evaluate different seed rate for green fodder production and its composition under hydroponic conditions.

II. 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 11^{th} 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

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 ANOVA was applied and comparison between means was done by LSD at 0.05 level of significance.

Fig 1: Hydroponic maize production in NCRP, Rampur

III. 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

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 ($p<0.001$)

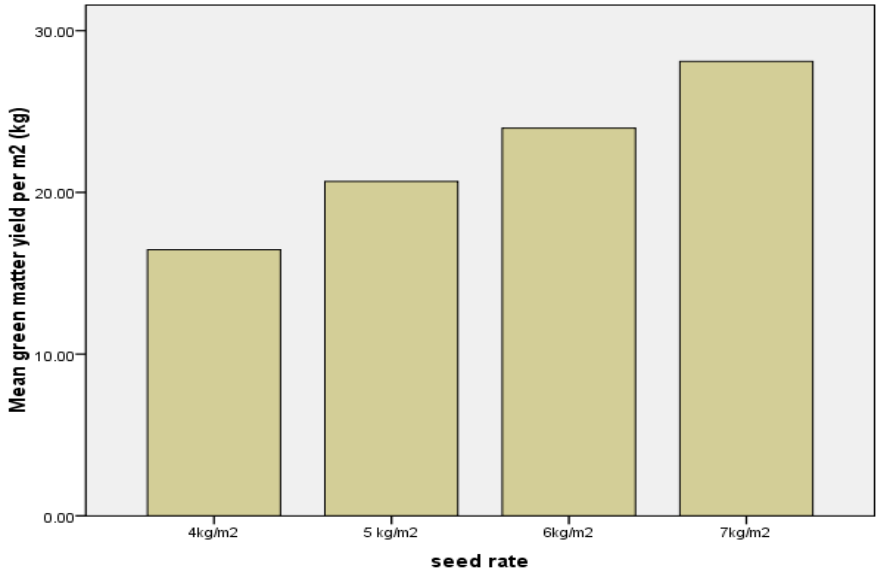

Fig 2: Mean green matter yield per m^2 in different seed rate

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 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.

IV. 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.

Acknowledgment:

The authors sincerely acknowledge Nepal Agriculture Research Council (NARC) for funding and directorate of livestock and fisheries research providing us to doing this research. We are very thankful to all helping hands of National Cattle Research Programme (NCRP) staffs during data collection period is highly appreciated.

References

[1.] Annual Report 2075/76 (2018/19). National Cattle Research Program, NARC, Rampur Chitwan, Nepal. pp. 50

[2.] AOAC. 2000. Official Methods of Analysis. 17th edn. Association of Official Analytical Chemists, Washington, DC

[3.] D. Cuddeford, "Hydroponic grass," *In Practice*, vol. 11, no. 5, pp. 211–214, 1989.

[4.] G. N. Al-Karaki, "Utilization of treated wastewater for green forage production in a hydroponic system," *Emirates Journal of Food and Agriculture*, vol. 23, pp. 80–94, 2011.

[5.] G. N. Al-Karaki and N. Al-Momani, "Evaluation of some barley cultivars for green fodder production and water use efficiency under hydroponic conditions," *Jordan Journal of Agricultural Sciences*.

[6.] G. Tudor, T. Darcy, P. Smith, and F. Shallcross, "The intake and live weight change of drought master steers fed hydroponically grown, young sprouted barley fodder (Autograss)," Department of Agriculture Western Australia, 2003.

[7.] Girma F and Gebremariam B. (2014). Review on Hydroponic Feed Value to Livestock Production. Journal of Scientific and Innovative Research 2018; 7(4): 106-109

[8.] M. H. Jensen and A. J. Malter, "Protected agriculture: a global review," World Bank Technical Paper 253, 1995.

[9.] M. M. Al-Hashmi, *Hydroponic green fodder production in the Arabian Gulf Region*, M.S. thesis, Faculty of Graduate Studies, Arabian Gulf University, Manama, Bahrain, 2008.

[10.] Naik P K, Dhuri R B, Swain B K and Singh N P. 2012. Nutrient changes with the growth of hydroponics fodder maize. Indian Journal of Animal Nutrition 29: 161–63

[11.] Naik P K, Dhuri R B, Karunakaran M, Swain B K and Singh N P. 2014. Effect of feeding hydroponics

maize fodder on digestibility of nutrients and milk production in lactating cows. Indian Journal Animal Sciences 84 (8): 880–83

[12.] Naik, P. K., Swain, B. K., Chakurkar, E. B., & Singh, N. P. (2017). Effect of seed rate on yield and proximate constituents of different parts of hydroponics maize fodder.Indian journal of animal sciences. Vol.87. pp. 109-112

[13.] Shipard, I.(2005). "How can I grow and use sprouts as living food?" Stewart publishing https://books.google.com.np/books/about/How_Can_I_Grow_and_Use_Sprouts_as_Living.html?id=rq7yPQAACAAJ&redir_esc=y

[14.] Tudor, G., Darcy, T., Smith, P., and Shallcross, F. (2003). The intake and liveweight change of droughtmaster steers fed hydroponically grown, young sprouted barley fodder (Autograss), Department of Agriculture Western Australia.