ISSN (Online): 2455-3662
EPRA International Journal of Multidisciplinary Research (IJMR) - Peer Reviewed Journal
Volume: 10| Issue: 10| October 2024|| Journal DOI: 10.36713/epra2013 || SJIF Impact Factor 2024: 8.402 || ISI Value: 1.188

DESIGN AND FABRICATION OF AUTOMATED HYDROPONIC SYSTEM FOR FODDER CROPS

Dr.A. Jany Giles[1], N.Janani[2], J.Joselin Zibia[3], T. Balaji[4], B.Kishore[5], R. Susmevaran[6], Dr.D.Rajkumar[7], R.Anitha[8]

[1,2,3,8]*Assistant Professor, Department of Agricultural Engineering, RVS Technical Campus, Coimbatore, Tamil Nadu, India -641 402*

[7]*Professor, Department of Agricultural Engineering, RVS Technical Campus, Coimbatore, Tamil Nadu, India -641 402*

[4,5,6]*Student, Department of Agricultural Engineering, RVS Technical Campus, Coimbatore, Tamil Nadu, India -641 402*

Correspondence: *Dr.D.Rajkumar, Professor, Department of Agricultural Engineering, RVS Technical Campus, Coimbatore, Tamil Nadu, India -641 402*

Article DOI: https://doi.org/10.36713/epra18724
DOI No: 10.36713/epra18724

ABSTRACT

The proposed system was developed for small and medium agriculture explorationsenabling fodder production in six days. Within the six days production timeline, the system in completely autonomous, i.e., controls the desired agronomic conditions for production. Moreover, the system controls the fodder flow, i.e., since its entrance (seeds) to the final production stage, through vertical and horizontal displacement ofthe fodder trays. The system was designed to produce the fodder in height, to diminish the occupied area in the greenhouse, due to the space the later solution occupies, and also to diminish the volume of air to acclimate, if needed. From the requirements above, is present in the paper the automatic solution that comprises: the mechanical structure, the mechanical and hydraulic components, and also the control system to automate the Hydroponic Automatic System (HAS).

KEY WORDS: *Hydroponics, Fodder production, Tray farming, Automatedsystem, Soil less farming.*

INTRODUCTION

Hydroponics is the method of soil less farming. In this setup both Irrigation and Nutrient supply are done by water supply through the spraying nozzles. These nozzles are fixed at the top of each tray in which plants are cultivated. In this method irrigation systems are managed by a sensor which auto runs in precise timing and runs the water flow. It involves calculated flow of nutrients and water in a five layered mixing tank. The solution is pumped into the gullies where plantsare grown with suitable supporting cups. The roots of the plants directly absorb water and minerals. Overflowing solution is collected in recycle tank and is pumped back to mixing tank for refuse. The automation enables easy graphical user interface based programmable timing control and other monitoring of system. Background The human population will grow to an estimated 8 billion people by 2025 and 9 billion by 2050, and it is widely recognized that global agricultural productivity must increase to feed the world population (sekhon, 2014). The increase in livestock production demands nutrient requirement to feed animals. Productive and reproductive performance of animals can be increased through feeding of green fodder. Now a days scarcity of land has been shown as a great constraint of forage production for ruminant animals. Having these and other problems in mind, alternative technologies like the hydroponics found critical (Naik et al., 2015). It is a technique of growing crops like barley without use of chemicals and artificial growth agents(soil). It is characterized by short growth period with around 7-10 days and need of a small piece of land for production (Mooney J, 2005). And has extraordinary protein, vitamins, fibers and mineral contents with their healthy beneficial effects on animals. Therefore, this technology is an important agricultural technique currently used in many countries (Tudor G. et al., 2005).
Automated hydroponics for fodder crop cultivation represents an innovative approach to modern agriculture, where plants are grown without soil, using nutrient-rich water solutions. This method offers a highly efficient, sustainable way to produce high-quality fodder, especially for livestock. Traditional soil-based agriculture faces challenges such as unpredictable weather, soil degradation, and water scarcity, all of which affect the consistent supply of fodder crops.

In contrast, automated hydroponic systems enable controlled, year-round production by precisely managing variables such as light, temperature, and nutrient levels. This technology optimizes resource use, reduces labor costs, and increases yields, making it particularly beneficial for regions with limited arable land or adverse climate conditions. By automating the cultivation process, farmers can improve both the quantity and quality of fodder, ensuring a reliable feed supply for animals and contributing to more sustainable agricultural practices. In this research the main objective is to

ISSN (Online): 2455-3662
EPRA International Journal of Multidisciplinary Research (IJMR) - Peer Reviewed Journal
Volume: 10| Issue: 10| October 2024|| Journal DOI: 10.36713/epra2013 || SJIF Impact Factor 2024: 8.402 || ISI Value: 1.188

cultivate fodder crop in Chemical free manner. To irrigate and manage Nutrient of the crop accurately to review the Hydroponic feed value to livestock production and to review principles of hydroponic fodder production and method of hydroponics fodder production.

METHODOLOGY

Hydroponic fodder production involves supplying cereal grain with necessary moisture and nutrients, to enable germination and plant growth in the absence of a solid growing medium. There are a range of chemical and structural changes that take place within the cereal grain through the hydroponic growing process. The number of sprouts produced (yield) and quality of the fodder is influenced by a number of factors including Grain, environment, Managementof the system etc.

Hydroponic fodder production system. To grow green fodder at wider temperature (15º - 32ºC) and humidity (70 -80 %) range without fungal growth. Environmentally friendly. Contamination free fodder. Saves water and labor. Fodder grown is highly palatable and nutritious. Fodder improves animal health and reproductive efficiency. Hydroponic maize fodder-Soaking for 24 hr. Maize seed is best choice for fodder production. Procure good quality maize seeds with at least 85% germination rate. Seed should be pesticide free. Separate impurities from seeds by impurities-separator. Weight 1.5 kg. seeds and allow to soak in water for 24 hr. in soakingtray.

HYDROPONIC FODDER GROWTH STAGE

Hydroponic fodder Growth.Stage-2nd Day: Transfer-soaked seed to tray and spread uniformly through it. Load trays on 1st two rows of racks.
Hydroponic fodder Growth.Stage-2nd Day: 1st day tray shift in 3rd & 4th rows of trays.

Hydroponic fodder Growth Stage-3rd Day: Respective below two rows of racks till they reach bottom two rows which coincides on 7th day.

Hydroponic fodder Growth Stage-4th Day: The environmental factors that influence in the forage production. The duration of daylight influences vegetative development. The ideal temperature is 21º C, and it should be as constant as possible.

Hydroponic fodder Growth Stage-5th Day: The watering system is electronically controlled and delivers water at the optimum rate. Hydroponic fodder Growth Stage-6th Day Adjusting nutrient flows: - Nutrient flows are adjusted across each stack, along with water.

Hydroponic fodder Growth Stage-7th Day: Mould is actively managed within sheds through pretreatment of the seed. Additives to the water are used for pre-soaking the grain to minimize therisk of mould. Shed hygiene is also important and thus considerable attention is paid. One tray containing 1.5 kg maize seeds produces 7-9 kg green fodderwith fodder height of 20-25 cm. Here irrigation system in Hydroponics is done using a sprinkler mist at regular intervals. water is sprayed to the crops every 2 hours for 1 minute in order to maintain the water availability for their growth. This is to ensure the water usage efficiently for irrigation purpose and precisive growth of the crop. Using A 100L drum the submersible water pump inserted in the drum. Water pump pushes the water by the implementation of dripper pipe with mist sprayer water sprays in the seed places trays.

RESULT AND DISCUSSION

EFFICIENCY OF AUTOMATED HYDROPONICS

Natural green fodder is the key to decreasing feeding cost during milk production. Due to non-availability and higher land costs, minimum Utilization of fodder producing areas to feed livestock. This system also eliminates additional pressure on already over worked irrigation system. It is the demand of the dairy owners in the states, were there is low land holdings, scarcity of water, saline water, higher labor and land cost. The hydroponics green fodder was looking like a mat consisting of roots, seeds and plants. There are differences in the nutrients content of hydroponics fodder maize during different stages of growth and maize grown in conventional practices. The increase in protein content may be attributed to the loss in dry weight, particularly carbohydrates, through respiration during germination and thus longer sprouting time was responsible for the greater losses in dry weight and increasing trend in protein content.

Lower Uniformity.
The absorption of nitrates facilitates the metabolism of nitrogenous compounds from carbohydrates reserves, thus increasing levels of CP. The CP content of conventional green fodder maize harvested at about 60 days was similar to the earlier findings.
The lower CF content and higher NFE content of the hydroponics green fodder than the conventional green fodder indicated the high leafy and succulent nature of the hydroponics green fodder which may be more palatable to livestock, particularly the dairy animals. There was an increasing trend in the TA content of the hydroponics fodder maize with the advancement of the period. However, the AIA values of the hydroponics fodder maize were similar and lower than the AIA content (1.40%) of the fodder maize harvested at about 60 days under conventional practices.

CONCLUSION

The production of livestock needs a healthy supply of fodder for better production. But during the dry season there seems to be a lean supply. There must therefore be an alternative like that of the production of hydroponic fodder. Hydroponics is a smart alternative technology against scarcity of land and impeding climate changes. The hydroponic system requires a fraction of conventional agriculture's water use while still offering high quality stock feed. Generally, this technology has a solution to avoid scarcity of green feeds especially in dry seasons and urban areas having a shortage of land and water for forage production. Having a characteristic of high intake palatable and digestible properties, this technology is best chosen than cereal grains and other concentrate feeding. In developed countries where there is no dearth of quality feed and fodder, the hydroponic production of fodder is less competitive than

ISSN (Online): 2455-3662
EPRA International Journal of Multidisciplinary Research (IJMR) - Peer Reviewed Journal
Volume: 10| Issue: 10| October 2024|| Journal DOI: 10.36713/epra2013 || SJIF Impact Factor 2024: 8.402 || ISI Value: 1.188

traditional fodder production when compared on per kg dry matter basis. High initial investment on fully automated commercial hydroponic systems and high labor and energy costs in maintaining the desired environment in the system adds substantially to the net cost of hydroponic fodder production. Such systems are not successful in developing countries. Conversely, low-cost hydroponic systems have been developed by utilizing locally available infrastructure where there is an acute shortage of fodder and water; local irrigation systems are not well established. Transportation and fuel costs are high; and seasonal variations of fodder prices are extreme.

Figure 1: Pictorial representation of Hydroponics

ISSN (Online): 2455-3662
EPRA International Journal of Multidisciplinary Research (IJMR) - Peer Reviewed Journal
Volume: 10| Issue: 10| October 2024|| Journal DOI: 10.36713/epra2013 || SJIF Impact Factor 2024: 8.402 || ISI Value: 1.188

REFERENCES

1. AI-Karaki, G.N. and AI-Hashimi, M, (2012) "Green fodder production and water use efficiency of some forage crops under hydroponic condition". Internl. School. Res. Network.
2. Al-Ajmi, A., Salih, A., Kadhim, I. and Othman, Y,(2009). "Yield and water use efficiency of barley fodder produced under hydroponic system in GCC countries using tertiary treated sewage effluents. J. Phytol. 1: 342-348.
3. Chandra, P., & Gupta, M. J. (2003). Cultivation in hi-tech greenhouses for enhanced productivity of natural resources to achieve the objective of precision farming. Precision Farming in Horticulture, 64-74.
4. Singh, J. (Ed.). (2013). Precision farming in horticulture. New India Publishing Agency.
5. Chavan, J. K., Kadam, S. S., & Beuchat, L. R. (1989). Nutritional improvement of cereals by sprouting. Critical reviews in food science & nutrition, 28(5), 401-437.
6. Dung, D. D., Godwin, I. R., & Nolan, J. V. (2010). Nutrient content and in sacco degradation of hydroponic barley sprouts grown using nutrient solution or tap water. Journal of Animal and Veterinary Advances, 9(18), 2432-2436.
7. Fazaeli, H., Golmohammadi, H. A., Tabatabayee, S. N., & Asghari-Tabrizi, M. (2012). Productivity and nutritive value of barley green fodder yield in hydroponic system. World Applied Sciences Journal, 16(4), 531-539.
8. Hillier, R. J., & Perry, T. W. (1969). Effect of hydroponically produced oat grass on ration digestibility of cattle. Journal of animal science, 29(5), 783-785.
9. Mukhopad, Y. (1994). Cultivating green forage and vegetables in the Buryat Republic.
10. O'Sullivan, J. (1982). Possible benefits in the culture of barley seedlings compared to barley seeds as fodder. Department of Horticulture. Dublin, University College Dublin.
11. Chikhalikar, A. D., & Khillare, R. S. (2021). Hydroponic fodder: An overview. Just Agriculture, 2(3), 1-4.
12. Sihombing, P., Karina, N. A., Tarigan, J. T., & Syarif, M. I. (2018, March). Automated hydroponics nutrition plants systems using arduino uno microcontroller based on android. In Journal of Physics: Conference Series (Vol. 978, p. 012014). IOP Publishing.
13. Pandey, R., Jain, V., & Singh, K. P. (2009). Hydroponics Agriculture: Its status, scope and limitations. Division of Plant Physiology, Indian Agricultural Research Institute, New Delhi, 20.
14. Sneath, R., & McIntosh, F. (2003). Review of hydroponic fodder production for beef cattle. Department of Primary Industries: Queensland Australia, 84, 54.
15. Bakshi, M. P. S., Wadhwa, M., & Makkar, H. P. S. (2018). Feeding strategies during natural calamities. Indian Journal of Animal Nutrition, 35(1), 1-21.