PRODUCTIVITY AND ECONOMICS OF HYDROPONIC FODDERSAS INFLUENCED BY HARVESTING TIME

ABSTRACT

In developing countries like India, the production of sufficient greenfodder to feed the livestock population has become a big challenge due to limited land allocation, a lack of irrigation facilities, and fertilizers & manure requirements for cultivation. To overcome this, hydroponics fodder production technology is emerging as an alternative to growing regular, sufficient-quality fodder. By keeping these views in mind, the study was undertaken to assess the **Influence of harvest time on yield and economics of hydroponically grown fodder crops**at Department of Agronomy. The actual structure of hydroponic fodder produced was erected at Maharashtra Animal and Fishery Science University, Panjabrao Deshmukh Krishi Vidyapeeth, Akola.

The investigation was carried out in a factorial randomized block design (FRBD) with three replicas. The study consisted of four different times of harvest (9^{th}, 11^{th}, 13^{th} and 15^{th} days of harvesting) and two fodder crops (maize and cowpea). The results revealed that the higher green fodder yield (26.64 kgm^{-2}) and dry matter yield (3.06 kgm^{-2}) were recorded on the 15^{th} day of harvesting in fodder crop Cowpea , whereas lower green fodder yield (18.58 kgm^{-2}) and dry matter yield (2.28 kgm^{-2}) were recorded on the 9^{th} day of harvesting in Maize. In terms of economics, the15^{th} day of harvesting has recorded a higher gross monetary return, net monetary return, and benefit-cost ratio in Cowpea.

Key words: Hydroponics, Fodder,FRBD, B:C Ratio

INTRODUCTION

In India Livestock contributes about 25% of the total agricultural GDP. A good fodder supply is required for better livestock production.The fodder, which is produced hydroponically, has a short growth period of 7–10 days, and only water is used to produce a fodder of shoot and root combinations (Al-Jutheryet *al.*, 2019).

As per the 20^{th} Livestock Census 2019, the livestock population of the country is 535.78 million, including 192.49 million (35.94%) cattle, 109.85 million (20.45%) buffaloes, 74.26 million (13.87%) sheep, 148.88 million (27.80%) goats and 9.06 million pigs (1.69%). The increasing trend in the livestock population, along with the intensive rearing system, has resulted in increased demands for feed and fodder in the country. The land allocation for the cultivation of green fodder is limited to only 5% of the gross cropped area (Shit, 2019). Presently, India is facing a net shortfall of 35.6% green fodder (Deo *et al.*, 2021). The scarcity of adequate land, fertilizer, irrigation, and labour along with the unavailability of green fodder throughout the year, are major constraints for fodder production and sustainable dairy farming (Hazra, 2014). Further, fodder production is adversely affected by climate change through the erratic distribution of rainfall (Gunasekaran *et al.*, 2017).

These problems can be overcome by hydroponics technology to produce green fodder for farm animals (Sneath and Mc Intosh, 2003; Naik *et al.*, 2016). Hydroponic fodders are a rich source of antioxidants in form of β-carotene, Vitamins A, E and C (Shipard, 2005) and rich in limiting amino acid, lysine. Hydroponic fodder is produced from cereal seeds like maize, barley, oats, millets and legumes like alfalfa, clover, horse gram and cowpea, which have high germinating capacity and fast-growing power. It is reported that hydroponic fodder increases digestibility of nutrients

and milk yield. Hydroponics fodder is a good source of chlorophyll, which is very important with a poor-quality roughage-based diet during drought conditions. Hydroponics requires 1 to 2 litres of water to produce 1 kilogram of fodder, compared to conventional fodder production, which requires 80–90 litres of water to grow 1 kilogram of green fodder. It saves about 95–97% of water and land required for fodder cultivation in a conventional system. (Al-Karaki and Al-Hashimi, 2012).

MATERIAL AND METHODS

The location of the experiment was at hydroponics facility of Maharashtra Animal and Fishery Science University, PDKV, Akola. The experiment was conducted using factorial RBD with two factors involving two crops and four times of harvesting, each repeated three times with a combination of a total 8 treatments. Each tray was made with vinyl fibre of dimensions 1.5 × 1 × 0.15 ft^3, with three 1.5 mm holes designed at both

sides. The seeds were dried under direct sunlight in open air one day before seed washing then it is washed in the bucket and the seeds were allowed to settle for 5 minutes where the light-weight floating seeds were taken out. After draining, the seeds and trays were washed with 0.1% sodium hypochlorite solution to control the formation of mould. The washed seeds are soaked in fresh water in a 1:2 proportion (1part seeds and 2 parts water) in a container. Maize seeds were soaked for 24 hours, and cowpeas for 6-7 hours. After soaking, water is drained out and placed in a clean, wet gunny or cotton cloth airtight for sprouting. After 24 hoursseeds were transferred into the tray.The automated fogging was adopted in the study, and the automation was set at one-minute for every two hours for maize and 30 seconds for every three hours for cowpea.

RESULTS AND DISCUSSION

The current study's findings, as well as relevant discussion, have been summarized under the following headings.

Effect of Crops

The data in Table 1 shows that the green fodder yield and dry matter yield were significantly influenced by the different fodder crops. The maximum green fodder yield of 23.48 kgm^{-2} was recorded with Cowpea, which was significantly higher than Maize (22.17 kgm^{-2}). The higher green biomass yield in Cowpea might be due to the higher yield parameters like fresh weight of shoot and roots.Similarly,the results revealed that the maximum dry matter yield was 2.92 kgm^{-2} with Cowpea, which was significantly higher than Maize (2.50 kgm^{-2}).The higher dry weight of Cowpea is directly related to total dry matter accumulation . These results are in conformity with the findings of Vennila (2018); Naik *et al*., (2016); Gnanaraj and Sundaram (2020) and El-Morsy *et al*. (2013).

Effect of Harvesting time

The data in Table 1 revealed that green fodder yield and dry matter yield were significantly influenced by the harvesting time. The maximum green fodder yield of 26.64 kgm^{-2} was recorded with 15^{th} day of harvesting , which was significantly superior from all the harvesting times.Biomass yield of the fodder crop depends on both external and internal factors. The increase in dry matter accumulation in seedlings has increased fresh biomass yield of the hydroponically grown maize and cowpea with respect to time.The maximum dry matter yield 3.06 kgm^{-2} was recorded in treatment 15^{th} day of harvesting) and lowest on 9^{th} day of harvesting (2.28 kgm^{-2}).Higher dry matter accumulation during different growth stages of Cowpea was mainly ascribed to increased photosynthetic ability and

their partitioning to different parts with the advancement of age.These results are in conformity with the findings of Dung *et al* (2010); Naik *et al*., (2016) and El-Morsy *et al*. (2013).

Table 1: Green fodder yield and Dry matter yield (kg m^{-2}) of hydroponically grown fodder crops as influenced by the time of harvest

Treatments	Greenfodder yield (kgm^{-2})	Dry matter yield (kgm^{-2})
C1- Maize	22.17	0.23
C2-Cowpea	23.48	0.27
SE (m) ±	0.09	0.01
CD at 1%	0.27	0.03
H1- Harvesting at 9th day	18.58	0.22
H2-Harvesting at 11th day	20.93	0.23
H3-Harvesting at 13th day	25.12	0.26
H4-Harvesting at 15th day	26.64	0.28
SE(m) ±	0.46	0.01
CD at 1%	1.41	0.04

Effect of Crops

Data presented in Table 2 revealed that the hydroponics fodder Cowpea has recorded a higher gross monetary return of Rs. 1570.26 m^{-2} and was found to be significantly superior to the fodder Maize Rs. 1186 m^{-2}. This might be due to the fact that the market value of cowpea fodder is high as it is a protein crop. So, it has resulted in the highest gross return. Cowpea has recorded higher net monetary return as Rs 477.76 m^{-2} and found significantly superior over the Maize Rs. 281.05 m^{-2}. B:C ratio of fodder Cowpea (1.43) was found significantly superior over the fodder Maize (1.30). This might be due to higher market value of hydroponic cowpea fodder .

Effect of Harvest time

The data presented in Table 2 further revealed that the harvesting time at H_4 (15th day of harvesting) recorded higher gross monetary return,net monetary return and benefit:cost ratio. 15th day of harvesting Rs.1610m^{-2} and was found significantly superior over the others. As the age advances, the total green fodder yield increases, which in turn increases the gross monetary return with harvesting on the 15th day after sowing.Higher net monetary return was observed on 15th day of harvesting Rs.579.79m^{-2} .This might be due to the fact that as the age advances the total green fodder increased and resulted in increased gross returns, but the additional savings in seed and labour cost resulted marginal increase in higher net returns.Higher benefit cost ratio was observed on 15th day of harvesting (1.55) and lowest on 9th day of harvsting(1.15).

CONCLUSIONS

From the above study, it was observed that higher green fodder yield and dry matter yield was recorded in cowpea as compared to maize, whereas in harvesting time higher green fodder yield and dry matter yield were recorded at 15th day of harvesting and was superior over other day of harvesting.

In terms of economics, it can be concluded that cowpea has a higher gross return, net return and B:C ratio.Harvesting the crop at 15th day has resulted in higher return but 13th day of harvesting time was found more economical due to higher increase in the rate of gross and net monetary return.

Table 2: Economics of hydroponically grown fodder crops as influenced by the time of harvest

Treatments	GMR Rsm^{-2}	NMR Rsm^{-2}	Costof Cultivation Rs m^{-2}	B:C ratio
Factor A- Crop				
C1- Maize	1186.28	281.05	905.21	1.30
C2-Cowpea	1570.26	477.76	1092.50	1.43
SE (m) ±	19.08	19.08	-	-
CD at 1%	57.86	57.86	-	-
Factor B – Harvesting time				
H1- Harvesting at 9th day	1117.97	151.14	966.80	1.15
H2-Harvesting at 11th day	1265.66	277.48	988.17	1.27
H3-Harvesting at 13th day	1518.73	509.19	1009.54	1.49
H4-Harvesting at 15th day	1610.70	579.80	1030.90	1.55
SE(m) ±	26.98	26.98	-	-
CD at 1%	81.83	81.83	-	-
Interaction				
SE (m) ±	38.15	38.15	-	-
CD at 1%	115.73	115.72	-	
GM	1378.27	379.40	998.85	1.37

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