YIELD AND NUTRITIVE VALUE OF BARLEY (HORDIUM VULGARI L.) FODDER GROWN IN SOIL AND HYDROPONIC SYSTEM

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Abstract: The study has been conducted at the livestock farm, College of Agriculture, Dr.B.S.K.K.V. Dapoli, 415712, Dist. Ratnagiri (M.S), India. The study was aimed to identify the effect of soil media and hydroponic system on nutrient profile of conventional and hydroponic barley fodder. Hydroponic unit was prepared using bamboo stands with three shelves (1 ft² distance each) with capacity of 120 plastic hydroponic trays of 30.3 x 8.2 x 6.0 ft length, height and width, internal setup firmed with semi-automated drip irrigation along with 0.4% slope for effective drainage of excess water. After 24-36 hours of germination in a gunny bag, germinated barley seeds were spread on the hydroponic tray at a rate of 350 grams per tray up on 2 ft² size and 1.5-2 cm thickness, while conventional barley fodder was grown on soil bed of 1 cm seed space and 1 feet raw space and at a seed rate of 36.36 gram/m² through frequent watering and proper management. After 60 days of growth period, 2.84 kg/m² of fresh conventional barley fodder was produced from 36.36 gm seed with 0.95 meter average plant height and 9kg hydroponic barley fodder was recorded per kg seed per 8th-day growth periods along with 26 cm height and 100 g of conventional and 6th, 7th and 8th-day hydroponic barley fodders were sub-sampled for proximate analysis. The Crude protein content of hydroponic barley fodder was highest (P<0.05) as 13.89±0.11% than conventional barley fodder as 8.14±0.34% and barley seed 11.11±0.11%, while ether extract observed as 3.60±0.01% at 8th-day growth period was highest (P<0.05) than conventional barley fodder 3.35±0.44% and seed form of 1.68±0.39%. The crude fibre content of dried barley seed was denoted as 8.9±0.21% and progressed (P<0.05) likely to 14.2±0.02% hydroponic and 23.45±0.44% conventional fodder, where as NDF value was 35.3±0.03% and 57.46±1.47% in hydroponic and conventional barley fodder, respectively. The value of total ash and ADF was highest (P<0.05) in conventional barley fodder as 4.23±0.06% and 38.36±0.04% than hydroponic barley fodder as 4.10±0.05% and 16.20±0.25%, respectively. Therefore, growing of barley fodder hydroponically improved nutrient values such as crude protein and ether extract along with increased fresh fodder biomass and achieved less crude fiber, neutral detergent fiber and acid detergent fiber than conventional barley fodder grown in soil medium.

Keywords: Barley fodder, Conventional, Growing, Hydroponic, Nutrient

Introduction: Fodder is the most important and profound input in livestock diet. Grass and legume species had been used as a major feed for livestock, however, due to less availability and low quality fodder, the maintenance and productivity of animals is not yet secured. Availability of green fodder is attenuated due to severe climate change, extra growing time (averagely 60 days), unavailability of enough land, deterioration of fertile soil and water resources competition between fodder and cereal crops [12]. While, demand of green fodder is increasing when fodder availability is limited and necessity of feed for animals and its cost increases causing important livestock losses and depressing the national economy. Therefore, it is felt as a need of the hour to explore and develop the possibility of improved fodder production in a better way. Hydroponic growing is a privilege and free of soil, chemical fertilizer, free of herbicides and pesticides where, producing 10 times the amount of conventional fodder as a traditional farming. Though, hydroponic fodder cannot replace the need of green fodder and hay completely, as it lacks in fibre content, but it is a better substitute for packaged feeds. Hydroponically grown green fodder is highly water efficient and reduces water waste and essential natural and manmade resources required to grow fodder while controlling the effects of climate and growing conditions [22]. Hydroponically growing fodder is the transformation of grains into high quality, very lush, highly nutritious, disease free grass and root combination animal feed produced in a versatile and intensive hydroponic unit [9]. Sprouting of grains has resulted an increase in quantity and quality of protein, sugars, minerals, vitamins and optimizing the general health and performance of young animals while minimizing feed costs [2]. Since the agriculture sector is greatly enhanced through the introduction of a new form of animal fodder that secures livestock health and production, then, the study was aimed to identify the "Yield and nutritive value of barley (*hordeum vulgare* L.) fodder grown in soil and hydroponic system."

Materials and Methods:

Experimental site: The experimental trial was conducted at the livestock farm, College of Agriculture, Dapoli. Installation of the hydroponic unit and fodders growing were done according to the standards described by [7]. Six (6), seven (7) and eight (8) days were considered for evaluation of the

trays produced quality hydroponic fodder. For cultivation of conventional barley fodder, 22 M^2 (1mx22m) plot of land was prepared and Barley seed (*hordeum vulgare* L.) was sown at loam soil of 1 cm seed space and 1 feet raw space and at a seed rate of 36.36 gram/m^2. The plot of land was watered daily and kept for 60 days growth period. 100 gm of 60 days old barley green fodder and Six (6), seven (7) and eight (8) days hydroponic barley fodder were sub-sampled to determine the nutrient composition following the standard techniques described by [7].

Results and Discussion:

Growing of conventional vs. hydroponic barley fodder: After 60 days of growth period, 2.84 kg/m^2 of fresh conventional barley fodder was harvested from 36.36 gm seed with 0.95 meter average plant height. The leaf and stem of the green barley fodder was measured to estimate the biomass production on limited space excluding the roots tightly embedded with soil. In the specially designed sprouting trays, a total of 9 kg hydroponic barley fodder embedded with white roots and green shoots were produced out of 1kg barley seed (87% germination rate) along with average plant height of 26 cm on 8^{th}-day. There were no media to grow the hydroponic fodder in the hydroponic unit except tap water (chemical free & pH, 5) and sprouting trays. The production conversion ratio was based on the amount of fresh fodder produced per kg of seed used [11] and [16]. The conversion ratio depends on factors such as type and quality of seed, overall management, sprinkling frequency, temperature and humidity inside the hydroponic unit and growth period [21]. This data agrees with the concepts of [18] 6-10kg, [11] and [10] 6-10kg, of hydroponic barley fodder per kg barley grain. This outcome was superior to the findings of [6] as 7.21kg at 8^{th}-day and [5] 3.7 kg at 7^{th}-day age of hydroponic barley fodder per kg barley grain. The 26 cm average plant height achieved during 8^{th}-day growth period was similar to the reports of [13] 15-30 cm in hydroponic barley fodder and [14] 20-30cm in hydroponic maize fodder.

Chemical composition: As the result indicated in **Table 1**(behind), the average per cent DM content of barley seed, conventional (60^{th} day) and hydroponic barley fodder (8^{th}-day) was found as 93.81±0.53%, 34.2±0.16% and 13.64±0.35% respectively. The lower per cent dry matter of hydroponic barley fodder may be due to the large uptake of water that initiates increasing metabolic activity of resting seeds leads to complete loss of dry weight (starch) during growing cycles of hydroponic fodder [12], whereas %DM of conventional barley fodder was significantly higher may be due to the increased photosynthetic activity impresses stage of maturity of whole plant portion leading to higher biomass production. Higher values were denoted by [14] as 18.30% DM and [20] as 26.07% in hydroponic maize fodder, where as 34.2±0.16% in conventional maize fodder as reported by [3]. The crude protein content obtained in hydroponic barley fodder (8^{th}-day harvest) was 13.89±0.11% highly superior as compared to 8.14±0.34% in conventional barley fodder (60 days harvest) and 11.11±0.11% in barley seed. The CP content of hydroponic barley fodder was highest may be due to sprouting that alters the amino acid profile of barley seeds and enriches the crude protein content of hydroponic fodder [12]. This was in agreement with the findings of [17] as 13.72% and lower than the results reported by [15] and [19] as 14.69% and 16.3%, respectively and higher than the reports of [14] and [18]. The ether extract content of hydroponic barley fodder obtained at 8^{th}-day growth period was 3.60±0.01%, higher ($P<0.05$) than barley seed of 1.68±0.39% and conventional barley fodder 3.35±0.44% and this may be due to the peak chlorophyll content observed at 8^{th}-day growth period. The EE value of hydroponic barley fodder approaches to the findings of [17], where they reported 3.72%, and better than the findings of [8] and [15] as 3.4% and 3.18%, respectively. The crude fiber contents of barley seed, hydroponic and conventional barley fodder were 8.9±0.21%, 14.2±0.02 % and 23.45±0.44%, respectively.The increased level of fiber in hydroponic and conventional barley fodder may be due to the buildup of structural carbohydrates such as such as lignin, cellulose and hemicelluloses [4]. This finding was at variance with the reports of [17] in hydroponic barley fodder as 16.33%. Higher CF values of conventional maize fodder was reported by [14] as 25.92% and [3] as 27.86±3.14%.The neutral detergent fiber of barley seed, hydroponic and conventional barley fodders were 20.1±0.04%, 35.3±0.03% and 57.46±1.47%, respectively. The value of hydroponic fodder was in line with the results of [6] as 35.40 % and better than [23] result of 31.25%.The total ash contents of the barley seed, hydroponic and conventional barley fodders were 1.81±0.01%, 4.10±0.05% and 4.23±0.06%, respectively. The nutritive values of barley fodders were similar with the results of [6], where they noticed 4.11% and higher than [8] as 3.6%. The level of acid detergent fiber was progressively increased from 8.00±0.03% in barley seed to 16.20±0.25% in hydroponic and 38.36±0.04% conventional barley fodder may be due to the progressive maturity of structural carbohydrates. The current finding of hydroponic barley fodder was superior to the results denoted by [23] as 14.35 ±0.21% and lower than the reports of [6] as 17.15%. Therefore, it can be concluded that, growing of barley fodder hydroponically improved nutrient values such as crude protein and ether extract along with increased fresh fodder biomass and achieved less crude fiber,

neutral detergent fiber and acid detergent fiber than conventional barley fodder grown In soil media.

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Table 1. Chemical composition of conventional vs. hydroponic barley fodder (%DM).

Variables	Obs.	Barley Seed (day 0)	Hydroponic Barley Fodder			Conventional Barley Fodder Harvested at 60 days period
			Day 6	Day 7	Day 8	
		Mean±SE	Mean±SE	Mean±SE	Mean±SE	Mean±SE
DM	3	93.81±0.53	16.25±0.75	14.13±0.19	13.64±0.35	34.2±0.16
CP	3	11.11±0.11	12.87±0.28	13.01±0.54	13.89±0.11	8.14±0.34
EE	3	1.68±0.39	2.36±0.63	2.78±0.24	3.60±0.01	3.35±0.44
CF	3	8.9±0.21	13.97±0.18	14.1±0.01	14.2±0.02	23.45±0.44
NDF	3	20.1±0.04	33.66±0.93	33.96±0.20	35.3±0.03	57.46±1.47
ASH	3	1.81±0.01	3.13±0.10	3.65±0.01	4.10±0.05	4.23±0.06
ADF	3	8.00±0.03	15.92±0.02	16.01±0.04	16.20±0.25	38.36±0.04

Obs.: observation DM: dry matter CP: crude protein EE: ether extract CF: crude fibre
NDF: neutral detergent fiber, Ash: ash ADF: acid detergent fiber, SE: standard error

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