



## The impact of different fertilizer applications and seed rates on the productivity of Hydroponic Green Forage of barley (*Hordeum vulgare* L.)

Al-Mothefer, Ahmad<sup>1\*</sup>; Jassim, Furat K.<sup>2</sup>; Jassim, Adel K.<sup>3</sup>; Mohsen, Arshad T M<sup>4</sup>.

<sup>1-4</sup> Aquaculture Unit, College of Agriculture, University of Basrah, Iraq.

\*Corresponding author e-mail: [ahmad.mohammed@uobasrah.edu.iq](mailto:ahmad.mohammed@uobasrah.edu.iq)

### Abstract:

A laboratory experiment was conducted at the College of Agriculture, University of Basra, in 2024-2025, to estimate the effect of different quantities of seeds, and different fertilization, on the productive characteristics of the sprouted barley crop. The experiment was applied according to a factorial arrangement using a Complete Random Design (CRD) with three replications, the first factor was: two types of fertilization: a neutral chemical fertilizer NPK 20 20 20, symbolized by (F1), and humic acid (F2). The second factor involved three seed quantities: 2, 4, and 6 kg m<sup>-1</sup>. The results showed that the neutral NPK fertilizer outperformed all the studied characteristics plant height 22.22 cm, and fresh weight was 233.83 g, and dry weight 39.06 g. the third seed quantity, 6 kg m<sup>2</sup>, outperformed all the studied characteristics, recording the highest total plant height of 26.90 cm, the highest fresh weight of 243.55 g, and the highest dry weight of 34.77 g. the interaction between fertilizer treatments and seed quantities, the results showed an effect on fresh weight, with treatment F1xS3 giving the highest fresh weight of 296.90 g. plate-1 compared to treatment F2xS1, which gave the lowest fresh weight of 194.80 g. plate-1.

**Keywords:** hydroponic; barley; Fertilizer; Green Forage Seeding Rate.

### Introduction

Currently, The world's attention turned hydroponics due to the need for vertical expansion in field crop production in general, and fodder production in particular. Hydroponic fodder has several advantages, including its high nutritional value, its palatability to animals due to its softness, its availability during periods of fodder scarcity, and its significant water savings compared to traditional agriculture. It also allows for increased vertical production through efficient use of land, and its

production costs are considerably lower than field farming. Furthermore, it reduces labor and mechanization, while increasing both the quantity and quality of production (Taghreed et al., 2023).

Hydroponics, or what is known as “hydroponics”, is a modern agricultural technique that relies on growing plants without the use of soil, by feeding them with an aqueous solution containing essential nutrients. This technique represents an innovative solution to the challenges of traditional agriculture, especially in light of

the limited natural resources and the increasing need to achieve food security. Thanks to complete control over the agricultural environment, plant density can be greatly increased, resulting in higher productivity on smaller areas.

Many crops are grown hydroponically, most notably barley, which is of high economic importance as it is used as animal feed due to its high nutrient content (Mahmoud, 2015). The exponential increase in population has led to a surge in demand for animal products, which in turn has increased the need for animal feed. This has resulted in rising feed prices. To overcome these price hikes, the development of alternative feed production has become a critical and urgent necessity. Several solutions exist to address the feed production crisis, including hydroponic feed production (Mahmoud, 2015). Chemical and organic solutions have been used to produce feed hydroponically and increase its yield (Rivero et al., 2016). Several factors influence hydroponic feed production, the most important being the quantity of seeds used. Researchers indicate that increased seeding rates lead to higher productivity (Al-Mursi et al., 2013). Hence came the idea of the study, which aims to investigate the effect of different quantities of seeds, as well as the effect of different fertilization on the characteristics of sprouted barley, and to determine which fertilizer used gives the best productivity for sprouted barley. It is worth mentioning that the production of fodder using hydroponics can contribute significantly to bridging a large part of the gap between production and market needs.

## **Results and discussion**

### **1. Plant height**

The results in Table 1 show that Treatment (F1) significantly outperformed Treatment (F2) by recording the highest average height

## **Material and methods**

A laboratory experiment was conducted at the College of Agriculture, University of Basra, in 2024-2025, to estimate the effect of different quantities of seeds, and different fertilization, on the productive characteristics of the sprouted barley crop. The experiment was applied according to a factorial arrangement using a Complete Random Design (CRD) with three replications. The research included two factors: The first factor was the use of two types of fertilization, namely balanced chemical fertilizer of NPK, which was given the symbol F1, and the second is humic acid, which was given the symbol F2. As for the second factor, different quantities of seeds were used, namely 2, 4, and 6 kg per square meter. Three replicates were used, and the grains were spread in cork trays with dimensions of 25 cm in length and 16 cm in width, with a quantity of seeds of 100 g per tray, which is equivalent to 2 kg per square meter. The research was conducted using a completely randomized design (RCD) with three replicates. The seed germination rate was 87%. All seeds were washed with tap water and sterilized to eliminate pathogens. After soaking for 24 hours, the seeds were weighed and placed in planting trays. The seeds were irrigated daily with sprinklers, four times a day. The SPSS statistical software was used to analyze the data, and the means were compared using the LSD method, as described by Al-Rawi and Khalaf Allah (1980). The measured traits were total green weight, dry weight, and plant height.

of the germinated barley plant, reaching 22.22 cm, compared to Treatment (F2), which recorded the lowest height of 20.37 cm. This may be due to the fact that NPK provides readily available nutrients to the

plant in the form of nitrogen, phosphorus, and potassium. Nitrogen is the primary catalyst for chlorophyll and proteins, which in turn stimulate cell division and expansion, thus increasing plant height (Marschner, 2012).

Table 2 also shows that treatment (S3) significantly outperformed the other treatments, recording the highest average height of the germinated barley plant, reaching 26.90 cm, compared to treatment

(S1), which recorded the lowest plant height at 17.13 cm. This may be due to the increased seed quantity, which led to overcrowding of the plants and subsequent competition for light, thus stimulating the production of auxin, a hormone that promotes faster stem elongation (Ballaré & Pierik, 2017).

However, the interaction between fertilizer type and seed quantity did not show any significant differences in the height of the germinated plant.

Table (1) effect for Nutrient type and Seed rates and their interaction on barley height (cm)

S	F		Average Nutrient type
	F1	F2	
S1	17.13	15.20	17.13
S2	22.63	20.43	22.63
S3	26.90	25.47	26.90
Average Seed rates	22.22	20.37	
L.S.D <sub>0.05</sub>	F	S	T X S
	1.015	1.243	N.S.

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**. wet weight**

The results in Table (2) show that treatment (F1) significantly outperformed treatment (F2) by recording the highest fresh weight of the germinated barley plant, reaching 233.83 g (tab-1), compared to treatment (F2), which recorded the lowest fresh weight of 212.33 g (tab-1). This may be due to the fact that NPK provides the macronutrients nitrogen, phosphorus, and potassium quickly and directly, increasing and stimulating vegetative growth and also leading to increased moisture in plant tissues (El-Morsy et al., 2021).

Table 3 also shows that treatment (S3) significantly outperformed the other treatments by recording the highest fresh weight of the germinated barley plant, reaching 243.55 g (tb-1), compared to treatment (S1), which recorded the lowest plant height at 186.40. This may be because

increasing the quantity of seeds led to an increase in the number of plants per unit area, which generates competition for light, leading to an increase in plant height through cell and stalk elongation. This, in turn, increases green weight and water content (Al-Karaki & Al-Momani, 2023). The interaction between fertilizer type and seed quantities showed significant differences, with treatment F1S3 recording the highest fresh weight at 296.90 g dish-1, compared to treatment F2S1, which recorded the lowest fresh weight at 194.80 g dish-1. This may be attributed to achieving a better balance between the plant's nutrient requirements and increased plant density per unit area, given that chemical fertilization improves root growth, which somewhat reduces competition between plants, thus optimizing resource utilization and leading to increased yield. (Ahmad, et al., 2023)

Table (2) effect for Nutrient type and Seed rates and their interaction on wet weight (g dish<sup>-1</sup>)

S	F		Average Nutrient type
	F1	F2	
S1	178.00	194.80	186.40
S2	226.60	252.00	239.30
S3	296.90	190.20	243.55
Average Seed rates	233.83	212.33	
L.S.D <sub>0.05</sub>	F	S	T X S
	9.81	12.01	16.99

### 3.

#### dry weight

The results in Table 3 show that treatment (F1) significantly outperformed treatment (F2) by recording the highest dry weight of the germinated barley plant, reaching 39.06 g (tab-1), compared to treatment (F2), which recorded the lowest dry weight of 27.31 g (tab-1). This may be due to the fact that NPK leads to increased photosynthesis and the formation of organic compounds within cells, which increases dry mass, and the increase in plant height and fresh weight is reflected in an increase in the plant's dry matter. (Youssef et al., 2022).

Table 3 also shows that treatment (S3) significantly outperformed the other

treatments, recording the highest dry weight of the germinated barley plant, reaching 34.77 g (tb-1), compared to treatment (S1), which recorded the lowest dry weight of 31.15 g. This may be due to the increased plant density resulting from the higher seed quantity, which led to increased plant height and green mass. Consequently, there is a greater accumulation of organic compounds and carbohydrates within the plant, which in turn leads to an increase in plant dry matter. (Al-Karaki & Al-Momani, 2023).

However, the interaction between fertilizer type and seed quantity did not show any significant differences in the dry weight of the germinated barley plant.

Table (3) effect for Nutrient type and Seed rates and their interaction on dry weight (g dish<sup>-1</sup>)

S	F		Average Nutrient type
	F1	F2	
S1	36.37	25.93	31.15
S2	39.6	27.67	33.64
S3	41.2	28.33	34.77
Average Seed rates	39.06	27.31	
L.S.D <sub>0.05</sub>	F	S	T X S
	1.633	2.001	N.S.

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