



Impact of Seeding Rate for Improved Growth and Forage Yield of Two Alfalfa (*Medicago sativa* L.) Varieties

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ABSTRACT

This study was conducted at the Grdarasha Research Station, College of Agricultural Engineering Sciences, Salahaddin University-Erbil, during the Autumn season of 2024-2025 to evaluate the impact of seeding rates on the growth, yield, and quality of two alfalfa (*Medicago sativa* L.) varieties: a local and an Italian cultivar. A factorial Randomized Complete Block Design (RCBD) was employed with three seeding rates (20, 40, and 60 kg ha⁻¹) and three replications. Key parameters assessed included plant height, number of branches, fresh and dry biomass, leaf/stem ratio, chlorophyll content, moisture content, and overall forage yield. Results showed that the Italian variety significantly outperformed the local one in terms of plant height (62.36 cm) and stem dry weight (7.67 g), while the local variety exhibited greater performance in number of branches (21.22), leaf dry weight (21.79 g), and leaf/stem ratio (4.97), indicating a more leaf-oriented growth pattern desirable for forage quality. Among seeding rates, the highest rate of 60 kg ha⁻¹ led to increased plant height (59.18 cm), fresh biomass (20.01 ton ha⁻¹), and dry yield (4.37 ton ha⁻¹), suggesting that higher density promotes productivity, although interactions with variety were evident. Significant variety × seeding rate interactions were observed for biomass yield, chlorophyll content, and moisture percentage. Notably, the local variety at 60 kg ha⁻¹ exhibited the best overall performance across multiple traits, underlining its adaptability and high yield potential under denser planting. The findings demonstrate the importance of optimizing both varietal selection and seeding rates to achieve maximum alfalfa production. These results can guide sustainable forage production practices in the Kurdistan Region's agro-ecological conditions.

Keywords: *Medicago sativa* L., variety, seeding rate, forage yield, growth performance, quality traits.

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INTRODUCTION

Forage crops are an essential component of most farming systems in the world today and are vital for supporting livestock producers globally. These crops are grasses, legumes and other plants that are grown to feed animals like cattle, sheep, goats, horses, etc. They feed the animals the nutrients and fibers they need [1]. Not only does the deliberate growing of forage crops enhance the efficiency of the feedlot and other livestock operations but it also enhances the environmental efficiency of farming enterprises [2]. They improve soil structure and water infiltration, decrease soil erosion, promote plant and animal life, and have specific ecological advantages [3]. Legume plants, such as peas, beans, clovers, and alfalfa, have acquired fame through their capacity to fix atmospheric nitrogen in cooperation with Rhizobium bacteria [4]. This process of fixing nitrogen makes the soil increase in this plant's essential nutrient and therefore reduces the use of synthetic nitrogen to fertilize plants [5]. Legumes also provide the protein, energy, and minerals needed for cattle development, health, and productivity [6]. Alfalfa (*Medicago sativa* L.), which is known as the 'king of forages' is one of the most significant and cultivated legume forages in the world. Alfalfa is important due to its high nutritional value [7]. This crop has the potential of yielding a high tonnage in a unit area, and it can thrive in almost all ecological regions because of its tolerance to variations in environmental conditions and soil types [8]. Alfalfa's deep taproots allow it to access water and nutrients from deeper soil layers, making it drought-resistant and effective in improving soil structure and reducing erosion [9]. Alfalfa like other forage crops, its production is determined by various agronomic factors of which include seeding rate as well as the cutting frequency [10]. The seeding rate which is the number of seeds placed in a unit area influences the plant density and competition that exist in the crop stand [11]. It is therefore important to achieve an optimal seeding rate to avoid a situation whereby, although there is high plant density light interception and nutrient uptake are reduced due to competition [12]. When a pasture area is over-seeded, plant competition is tight for the limited resources available hence the pastures gain less vigor and the forage quality is inferior [13]. Seeding rates that are too low results in the thinning of the crop which provides room for the weeds to grow and competes with the crop hence reducing the yields of the crop [14]. Therefore, striking the right balance on seeding rates

is key for achieving optimum production and, at the same time, having a healthy and productive stand of alfalfa [15]. Another critical management factor is varietal selection for alfalfa. It is crucial to realize that different varieties of alfalfa may have varied reactions to the rates of seeding and level of cutting, based upon their genetics regarding disease, drought or re-growth factor [16]. Thus, the current findings in plant breeding have made it possible to come up with improved alfalfa varieties with possibly desirable characteristics that can be used to boost yield, quality and management in various production practices [17]. Nevertheless, based on the obtained results, further detailed studies of the productivity of these varieties under specific seeding rates and varietal selection are required to give farmers proper recommendations on how to increase forage production in particular conditions of their agroecological zones [18]. Given the rising population demands for source foods such as milk, meat, and eggs and the high call for sustainable agriculture, productivity and efficiency in the production of alfalfa cannot be overemphasized [19]. Effective management of seeding rates and different varieties can significantly enhance the forage yields and the quality of the crop, which in turn increases the feasibility of animal farming and the sustainability of the agroecosystems [20]. Given alfalfa's central role in global forage systems, understanding the impacts of these factors on different varieties is critical for optimizing production in various agricultural environments [21]. The general objective of this study is to examine the response of two different varieties of *Medicago sativa* L. and seeding rates in terms of growth, yield, and quality.

Materials and Methods

Plant Materials

Two alfalfa (*Medicago sativa* L.) varieties were used in this study: a local variety (V1) and an Italian variety (V2). The experiment investigated the effect of three seeding rates—20, 40, and 60 kg ha⁻¹—on their growth, yield, and quality performance.

Experimental Site and Design

Field experiment was conducted during Autumn season 2024-2025 at the Grdarasha Research Station, College of Agricultural Engineering Sciences, Salahaddin University–Erbil (Latitude 36°11'356"N, Longitude 44°01'987"E; altitude 418 m above sea level). The experimental design was a factorial structure in a Randomized Complete Block Design (RCBD) with three replications. There were 12 plots in each block, and each plot was 1 m² (1 m × 1 m), having four rows at a distance of 0.25 m between them. There was a spacing of 0.30 m and 1 m between plots and blocks, respectively. Prior to sowing, the seed viability was determined by laboratory germination tests, and they had a germination percentage of more than 90% in both varieties.

Soil Sampling and Analysis

Before planting, composite soil samples were collected randomly from the top 0–30 cm soil depth across the experimental site. Physical and chemical properties were analyzed at the College of Agriculture and Forestry Research Center, University of Mosul. The results are presented in Table 1.

Table 1 Physical and Chemical properties of the soil at the experimental field

Soil type	Unit	Average value
Ph	-	7.6
Electrical Conductivity	ds.m ⁻¹	0.60
Organic Matter	%	1.58
Total CaCo3	%	18
Particle Size Distribution	Clay	%
	Silt	%
	Sandy	%
	Textural name	Sandy clay Loam
Bulk density	g/cm ³	1.1
Humidity	%	4.09
K	Ppm	2
P	Ppm	2.58
N	%	0.0084

Measured Parameters:

Growth Parameters

- **Plant Height (cm):** Measured from the base to the apex of the main stem on four randomly selected plants per plot.
- **Number of Branches per Plant:** Counted manually from the same sampled plants.

Yield and Biomass Parameters

- **Fresh Weight (g):** Total weight of harvested plant material (leaves and stems) before drying.

- **Dry Weight (g):** Measured after oven-drying plant samples at 70°C for 48 hours.
- **Dry Matter Percentage (DM%):**

It is a critical measure for determining the moisture-free part of a sample. It is using the following calculated formula:

$$\text{DM\%} = \frac{\text{Dry weight (g)}}{\text{Fresh weight (g)}} \times 100 \quad [10; 12]$$

The DM% provides a reliable measure of the proportion of solid material, excluding water content, within the sample.

Total forage fresh yield (ton/ha):

Consists of fresh (stems + leaves) g of all plants in the plot and converts to ton/ha.

Total forage dry yield (ton/ha):

Total dry weight of (stems + leaves) g of all plants in the plot and converts to ton/ha.

Leaves /stem ratio:

This was estimated using the following calculation [22].

$$\text{Leaf /stem ratio} = \frac{\text{total dry leaves wieght (g)}}{\text{total dry stem wieght (g)}}$$

Dry matter yield (DMY):

This information about the productivity of forage under particular conditions quantifies the total dry matter produced per unit area. It is computed using the following formula:

$$\text{(DMY)} = \text{Fresh weight} \times \frac{\text{Dry matter percentage}}{100} \quad [10; 22]$$

Forage quality parameters in the cutting period:

Chlorophyll Content:

The chlorophyll content was obtained by using a portable chlorophyll meter SPAD-502 (Minolta Co. Ltd. Japan). The mean of 3 chlorophyll content readings were obtained from the three leaves at 3 position (bottom, middle and top) plant⁻¹ as previously described by [23].

Total moisture content (%):

Moisture content of (stems+ leaves) at dry weight was determined by [24].

$$\text{Moisture content \%} = \frac{A-B}{C} \times 100$$

Where:

A = sample before Weight drying.

B = Weight after drying.

C = Weight before drying

Statistical Analysis

Data were subjected to analysis of variance (ANOVA) to assess the effects of variety, seeding rate, and their interaction on all measured parameters. Means were compared using appropriate post-hoc tests at a 5% significance level. All analyses were conducted using Minitab Statistical Software, Version 21.

Results and Discussion

Effect of varieties and seeding rate on some growth and forage characters of *Medicago sativa* L.

Table 2 shows the significant effect of both varieties and varied seeding rates on the plant height, number of branches, stem dry weight, leaf dry weight, and leaf/stem ratio per plant. The tallest plant height measurement occurred in the Italian variety at (62.361 cm), while the shortest plant height was recorded in the local variety at (49.317 cm). Results showed that the maximum number of branches (21.222) was obtained due to the local variety. However, the lowest values of the number of branches (17.444) were recorded from the Italian variety. The highest values of stem dry weight (7.666 g) were recorded from the Italian variety. However, the lowest values of stem dry weight (5.833 g) were recorded from the local variety. Also, the maximum value of leaf dry weight (21.789 g) was recorded from the local variety. Nevertheless, the lowest values of leaf dry weight (20.644 g) were recorded from the Italian variety. However, the local variety has a leaf/stem ratio of (4.967), indicating a higher allocation of resources to leaves, which may be suited for environments where maximizing photosynthesis is essential. The Italian variety, with a ratio of (2.822), allocates more resources to stems, suggesting a focus on structural support and resource transport, likely better suited for tougher environmental conditions. The local variety represents the maximum leaf/stem ratio, and the Italian variety represents the minimum ratio [25]. The highest values of plant height, number of branches, stem dry weight and leaf dry weight (59.183cm, 21.333, 8.117g and 22.45g respectively) were recorded from seeding rate 60 kg/ha. However, the lowest values of plant height, number of branches, stem dry weight and leaf dry weight (53.250 cm ,17.833, 4.267 g and 20.00 g respectively) were recorded from the seeding rate 40 kg/ha, seeding rate 20 kg/ha, seeding rate 40 kg/ha seeding rate 20 kg/ha. An increased leaves/stems ratio in seeding rate 40 kg/ha (6.100) means leaves are being produced compared to stems to a greater extent, which means leaves grow more relative to the stems. The smaller ratio of the seeding rate, 20 kg/ha (2.733), suggests increased development in stems compared to leaves. It can be explained by a shift in growing conditions or factors like seeding rate.

Table 2 Effect of varieties and seeding rate on some growth and forage characters of *Medicago sativa* L. Means that do not share a letter are significantly different.

Treatment	Plant height (cm)	Number of branches	Stem dry weight (g)	Leaf dry weight (g)	Leaf /stem ratio
Varieties					
V1	49.317 a	21.222 a	5.833 b	21.789 a	4.967 a
V2	62.361 b	17.444 b	7.666 a	20.644a	2.822 b
Seeding rate					
S1	55.083 b	17.833 b	7.867 a	20.00 a	2.733 b
S2	53.250 b	18.833 b	4.267 b	21.20 a	6.100 a
S3	59.183 a	21.333 b	8.117 a	22.45 a	2.850 b

(V1= Local variety, V2= Italian variety, S1= 20 kg/ha, S2=40 kg/ha, S3= 60 kg/ha).

Interaction effects of varieties and seeding rate on some growth and forage characters of *Medicago sativa* L.

Data represented in Table 3 illustrate the interaction effect between varieties and seeding rate on some growth and forage characteristics of *Medicago sativa* L. The variation in plant height is a maximum interaction effect between varieties and seeding rate. The Italian variety with a higher seeding rate of 60 kg/ha will have its growth potential maximized, thus being reflected in a taller plant height of (70.000 cm). In contrast, the local variety (V1) with a lower seeding rate of 40 kg/ha is presumed to have lower growth requirements, resulting in a shorter plant height of (46.583 cm). The seeding rate affects how each variety contends for available water, nutrients, and light, which has implications for overall growth. The maximum value of the number of branches (23.333) was recorded at the local variety* seeding rate of 60 kg/ha. Nevertheless, the lowest value of a number of branches (15.333) was obtained from the Italian variety with seeding rate of 20 kg/ha. The Italian variety with seeding rate of 20 kg/ha had the highest stem dry weight value (9.933 g). However, the local variety with seeding rate of 40 kg/ha produced the lowest recorded value of stem dry weight (2.600 g). The local variety *seeding rate of 60 kg/ha, recorded the greatest value of leaf dry weight (22.767g). However, the lowest value of leaf dry weight (19.767g) was recorded from the Italian variety with seeding rate of 40 kg/ha. The local variety at 60 kg/ha possibly developed more effectively at this planting rate, yielding more leaf dry weight, whereas the Italian variety at 40 kg/ha may have been less compatible with this seeding rate, leading to reduced leaf dry weight. The high leaf/stem ratio (8.833, respectively) was recorded by the local variety with seeding rate of 40 kg/ha. However, the lowest values of leaf/stem ratio (2.000, respectively) were recorded from the Italian variety* seeding rate of 20 kg/ha. The local variety at 40 kg/ha perhaps dedicated more resources to foliar growth, resulting in a larger leaf/stem ratio, whereas the Italian variety at 20 kg/ha may have promoted stem development, yielding a lower leaf/stem ratio [26].

Table 3 Interaction effects of varieties and seeding rate on some growth and forage characters of *Medicago sativa* L. Means that do not share a letter are significantly different

Treatment	Plant height (cm)	Number of branches	Stem dry weight (g)	Leaf dry weight (g)	Leaf /stem Ratio
varieties * seeding rate					
V1 S1	53.000 cd	20.333 b	5.800 b	19.967 a	3.467 b
V2 S1	57.167 bc	15.333 c	9.933 a	20.033 a	2.000 c
V1 S2	46.583 e	20.000 b	2.600 c	22.633 a	8.833 a
V2 S2	59.917 b	17.667 bc	5.933 b	19.767 a	3.367 b
V1 S3	48.367 de	23.333 a	9.100 a	22.767 a	2.600 bc
V2 S3	70.000 a	19.333 b	7.133 b	22.133 a	3.100 bc

Effect of varieties and seeding rate on forage yield of *Medicago sativa* L.

The highest values of fresh yield (18.652 ton/ha) were recorded from the local variety, as presented in (Table 4). However, the lowest values of fresh yield (18.489 ton/ha) were recorded from the Italian variety. Nevertheless, no significant difference was found in dry yield, as shown in Table 4. The results indicated that the Italian variety recorded maximum dry yield, dry matter percentage, and dry matter yield (4.083 ton/ha, 22.292%, and 4.055 ton/ha), but the local variety gave the minimum (4.006 ton/ha, 21.633% and 3.991 ton/ha). The highest values of fresh yield and dry yield (20.007 ton/ha and 4.358 ton/ha, respectively) were recorded from the seeding rate of 60 kg/ha. However, the lowest values of fresh yield and dry yield (17.657 ton/ha and 3.769 ton/ha, respectively) were recorded from the 20 kg/ha seeding rate. Furthermore, the highest dry matter percentage for a 40 kg/ha seeding rate is 22.588%. while the lowest dry matter percentage, 21.483%, was recorded at a seeding rate of 20 kg/ha. The highest dry matter yield (4.367 ton/ha) at a seeding rate of 60 kg/ha is most likely owing to suitable plant density, which promotes faster development and greater yield. The minimal dry matter yield (3.763 ton/ha) at 20 kg/ha may be due to lower plant density, which reduces competition for resources and lowers total yield. Maximum yield was

realized at a 60 kg/ha seeding rate due to optimum plant density, which enhanced growth and yield. The minimum yield at 20 kg/ha would be due to low plant density, which reduced competition but limited overall production [27].

Table 4 Effect of varieties and seeding rate on forage yield of *Medicago sativa* L. Means that do not share a letter are significantly different.

Treatment	Fresh yield (ton /ha)	Dry yield (ton /ha)	DM%	DMY (ton /ha)
Varieties				
V1	18.652 a	4.006 a	21.633 a	3.991 a
V2	18.489 a	4.083 a	22.292 a	4.055 a
Seeding rate				
S1	17.657 b	3.769 b	21.483 a	3.763 a
S2	18.048 ab	4.006 ab	22.588 a	3.940 a
S3	20.007 a	4.358 a	21.817 a	4.367 a

DM = Dry matter, DMY=Dry matter yield.

Interaction effects of varieties and seeding rate on some forage yield of *Medicago sativa* L.

The results were shown in (table 5) illustrated the significant influence of the interaction effects of varieties and seeding rate on means of fresh yield, dry yield, dry matter percentage, and dry matter yield of the plant. The maximum value of fresh yield, dry yield, dry matter percentage, and dry matter yield (20.433 ton /ha, 4.480 ton/ha, 23.100% and 4.510 ton/ha), were logged on the (local variety* seeding rate *60 kg/ha, local variety* seeding rate 60 kg/ha, Italian variety * seeding rate 20 kg/ha and local variety* seeding rate of 60 kg/ha) respectively. However, the lowest mean values of fresh yield, dry yield, dry matter percentage, and dry matter yield (15.983 ton/h, 3.689 ton/ha, 19.867% and 3.617 ton/ha) were logged on the (Italian variety * seeding rate 20 kg/ha, local variety* seeding rate 40 kg/ha, local variety* seeding rate 20 kg/ha and local variety* seeding rate 40 kg/ha). Variability in plant response to different varieties and seeding rates in *Medicago sativa* L. is likely because each variety will have specific growth characteristics, and the seeding rate will influence how plants compete, space, and utilize resources. The local variety, particularly when the seeding rate is at 60 kg/ha, seems to be better adapted to the current conditions, thus leading to higher yields. By contrast, the Italian variety and lower seeding rates have manifested poorer performance due either to less favorable growth conditions or to interplant competition [28].

Table. 5 Interaction effects of varieties and seeding rate on some forage yield of *Medicago sativa* L. Means that do not share a letter are significantly different

Treatment		Fresh yield (ton /ha)	Dry yield (ton /ha)	DM%	DM yield (ton /ha)
Varieties * Seeding rate					
V1	S1	19.330 ab	3.848 bc	19.867 a	3.846 a
V2	S1	15.983 c	3.691 c	23.100 a	3.679 a
V1	S2	16.193 bc	3.689 c	23.067 a	3.617a
V2	S2	19.903 a	4.323 ab	22.110 a	4.262 a
V1	S3	20.433 a	4.480 a	21.967 a	4.510 a
V2	S3	19.580 a	4.236 abc	21.667 a	4.227 a

Effect of varieties and seeding rate on chlorophyll content (SPAD), Stem fresh weight (g), Leaf fresh weight (g) and Moisture content% of *Medicago sativa* L.

Table 6 displays the variation between the two *Medicago sativa* L. varieties and the effect of varied seeding rates on chlorophyll content, stem fresh weight, leaf fresh weight, and moisture content % of the plant. The highest chlorophyll content values were recorded in the local variety (38.767), while the lowest were obtained in the Italian variety (37.911). The maximum value (34.156g) and lowest value (30.511g) in the stem fresh weight were recorded in the local variety and Italian variety, respectively. No significant variation was found between the local variety and the Italian variety in leaf fresh weight (g). The highest values of moisture (78.367 %) were recorded from the local variety. However, the lowest values of moisture (77.700 %) were recorded from the Italian variety. On the other hand, the maximum chlorophyll content (39.433) occurs at a 20 kg/ha seeding rate, while the minimum (37.700) occurs at a 40 kg/ha seeding rate, suggesting that higher seeding rates reduce chlorophyll content due to increased competition among plants. The highest stem fresh weight (36.867) is observed at a seeding rate of 20 kg/ha, but the lowest weight (24.867) is recorded at a seeding rate of 40 kg/ha, signifying that lowered seeding rates enhance growth and stem development, while increased seeding rates lead to diminished growth. Nevertheless,

the maximum leaf fresh weight of 68.983 at a seeding rate of 60 kg/ha shows improved development because of decreased competition and optimal spacing, whereas the lowest weight of 54.417 at 40 kg/ha indicates diminished growth, perhaps owing to overcrowding and resource competition. However, no significant differences were found in moisture content percentage on the different level seeding rates. *Medicago sativa* L. is affected by varieties and seeding rate because different varieties have unique growth patterns, and seeding rate influences plant spacing and competition for resources. Higher seeding rates increase competition, limiting growth, while lower rates allow for larger plants with better resource access. These factors impact chlorophyll content, fresh weight, and moisture content [29]

Table 6 Effect of varieties and seeding rate on chlorophyll content (SPAD), Stem fresh weight (g), Leaf fresh weight (g) and Moisture content% of *Medicago sativa* L. Means that do not share a letter are significantly different

Treatment	Chlorophyll content	Stem fresh weight (g)	Leaf fresh weight (g)	Moisture content %
Varieties				
V1	38.767 a	30.511 b	63.456 a	78.367 a
V2	37.911 a	34.156 a	63.767 a	77.700 a
Seeding rate				
S1	39.433 a	36.867 a	67.433 a	78.483 a
S2	37.700 a	24.867 b	54.417 b	77.417 a
S3	37.883 a	35.267 a	68.983 a	78.200 a

Interaction effect of varieties and seeding rate on chlorophyll content (SPAD), stem fresh weight (g), leaf fresh weight (g) and moisture content % of *Medicago sativa* L.

On the examined chlorophyll content, stem fresh weight, leaf fresh weight and moisture content properties, (table 7) displays the significant interactions between different varieties and seeding rate. The maximum chlorophyll content (42.422) was recorded from the local variety * seeding rate 20 kg/ha. However, the lowest chlorophyll content (36.167) was logged from the local variety * seeding rate 60 kg/ha. The highest stem fresh weight (44.933 g) was recorded for the Italian variety * seeding rate of 20 kg/ha. The lowest values of stem fresh weight (21.600 g) were obtained from the local variety * seeding rate of 40 kg/ha. The highest leaf fresh weight (78.133g) for the local variety was obtained at a seeding rate of 60 kg/ha, while the lowest leaf fresh weight (52.933g) was recorded at local variety * 40 kg/ha. This implies that a higher seeding rate (60 kg/ha) produces more leaf fresh weight. The maximum value of moisture content (80.100%) was recorded from the local variety * seeding rate of 20 kg/ha. However, the lowest values of moisture content (76.867%) were recorded from the Italian variety * seeding rate of 20 kg/ha. Different seeding rates and types have an impact on resource allocation, which explains the variance in moisture content, stem and leaf fresh weight, and chlorophyll concentration. At 20 kg/ha, the Italian variety puts more emphasis on stem development than moisture content, whereas the local variety maximizes both chlorophyll and moisture content [30].

Table 7 Interaction effect of varieties and seeding rate on chlorophyll content (SPAD), stem fresh weight (g), leaf fresh weight (g) and moisture content % of *Medicago sativa* L. Means that do not share a letter are significantly different

Treatment		Chlorophyll content	Stem fresh weight (g)	Leaf fresh weight (g)	moisture content %
varieties * seeding rate					
V1	S1	42.433 a	28.800 b	59.300 b	80.100 a
V2	S1	36.433 b	44.933 a	75.567 a	76.867 a
V1	S2	37.700 ab	21.600 c	52.933 c	76.933 a
V2	S2	37.700 ab	28.133 b	55.900 b c	77.900 a
V1	S3	36.167 b	41.133 a	78.133 a	78.067 a
V2	S3	39.600 ab	29.400 b	59.833 b	78.333 a

Conclusion

The results obtained in this study showed revealed that *Medicago sativa* L. varieties and seeding rates significantly affect growth, forage characteristics, yield, and physiological traits. The Italian variety exhibited the highest plant height and stem dry weight, while the local variety showed superior branch number, leaf dry weight, and fresh yield. Higher seeding rates (60 kg/ha) enhanced plant growth, fresh and dry yield, whereas lower rates (20 kg/ha) improved chlorophyll content and stem fresh weight. Interaction effects showed that optimal growth conditions vary between varieties. These findings suggest that selecting appropriate varieties and seeding rates can optimize productivity in different environmental conditions.

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تحسين معدل البذار لتحسين النمو وإنتاج العلف في صنفين من نبات الفصة (*Medicago sativa* L.)

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الخلاصة

أجريت التجربة في محطة أبحاث الكركرة التابعة لكلية علوم الهندسة الزراعية، جامعة صلاح الدين - أربيل، خلال موسم الخريف لعام 2024، بهدف دراسة تأثير معدلات البذار المختلفة على النمو والإنتاجية والجودة في صنفين من نبات الفصة (*Medicago sativa* L.) - أحدهما محلي والآخر إيطالي. تم اختبار ثلاثة معدلات بذار (20، 40، و60 كغم.هـ¹) باستخدام تصميم القطاعات العشوائية الكاملة العاملية. شملت المعايير المقاسة: ارتفاع النبات، عدد الفروع، الوزن الطازج والجاف، نسبة الورقة إلى الساق، محتوى الكلوروفيل، المحتوى الرطوبي، والإنتاج الكلي للعلف. أظهرت النتائج أن الصنف الإيطالي سجل أعلى ارتفاع للنبات (62.36 سم) ووزن جاف للساق (7.67 غرام)، بينما تفوق الصنف المحلي في عدد الفروع (21.22 فرع)، والوزن الجاف للأوراق (21.79 غرام)، ونسبة الورقة إلى الساق (4.97). عزز أعلى معدل بذار (60 كغم.هـ¹) بشكل ملحوظ كلاً من ارتفاع النبات، الكتلة الحيوية الطازجة، والإنتاج الجاف (59.18 سم، 20.01 طن.هـ¹، و4.37 طن.هـ¹ على التوالي). ومن المثير للاهتمام أن التداخل بين الصنف ومعدل البذار أثر بشكل معنوي على إنتاجية الكتلة الحيوية، محتوى الكلوروفيل، والمحتوى الرطوبي، حيث كان الصنف المحلي تحت معدل بذار 60 كغم.هـ¹ الأفضل بشكل عام. تشير النتائج إلى أهمية اختيار التوليفة المثلى من الصنف ومعدل البذار لتحقيق أعلى إنتاجية للفصة ضمن الظروف البيئية الزراعية المحلية.

الكلمات المفتاحية: صنف، معدل البذار، إنتاج العلف، الأداء النموي، صفات الجودة. *Medicago sativa* L.