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Effect of Cutting Dates on Forage Yield of Three Vicia Varieties (*Vicia Spp.)* in Sulaimani Governorate.

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Abstract

During the winter season of 2021-2022, a field experiment was conducted at Qlyasan locations in Sulaimani governorate. The aim of this research was to examine the consequence of cutting dates on the yield of forage and seeds, as well as on the components of various *Vicia* varieties. The experiment was designed as a factorial design and conducted using a randomized complete block design. The least significant difference (L.S.D.) test with a significance level of 5% was used for the statistical analysis. The three *Vicia* varieties tested were common vetch (*Vicia sativa*), narbon vetch (*Vicia narbonensis*), and bitter vetch (*Vicia ervilia*). Two cutting dates were used, namely, control (Co, no cut), cut 1 (80 days after sowing), and cut 2 (20 days after the first cut). The findings of this research demonstrated that the interaction between common vetch and cutting at 80 days after sowing produced the highest values of the dry matter percentage trait. Meanwhile, the interaction between narbon vetch and cutting 20 days following the initial cut produced the maximum fresh yield (ton/ha) and stem dry weight (g) values. The highest recorded values for the characteristics "pod count per plant" and "seed yield (kg/ha)" were obtained through the interaction between the control treatment and narbon vetch. However, the interaction between cutting at 80 days after sowing and narbon vetch produced the highest values of the 100-seed weight trait (gm). The variation in climatic conditions between seasons may explain these results.

Key words: Common vetch, Narbon vetch, Bitter vetch, Seed Yield, Cutting, and Forage Yield.
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Introduction

Forage legumes play a crucial role in sustainable agriculture, providing nutritious feed for livestock and improving soil fertility. Among the different forage legumes, *Vicia* species are widely cultivated in many countries, including Iraq, due to their high yield potential and adaptability to different soil and climate conditions. However, the yield and quality of *Vicia* forage and seed can be affected by various factors, such as cutting management practices [1,2,3].

The Vicia genus consists of approximately 190 species globally. These species are predominantly located in Mediterranean regions, with some also present in temperate areas of the northern hemisphere and extra-tropical regions in South America. In Iran, there are roughly 47 vetch species, the majority of which are wild varieties and typically cultivated without irrigation. Among these species, *Vicia narbonensis* (known as narbon vetch), *Vicia sativa* (common vetch), and *Vicia villosa* (referred to as woolly-pod vetch) are cultivated for use as livestock feed in both humid and semi-dry areas [4]. For cattle feed and to increase soil fertility, common vetch (*Vicia sativa*), an annual cool-season legume, is often planted in Mediterranean climates with an average annual rainfall of 250 to 350 mm. [5,4]. Traditional spring cultivation of common vetch is often affected by droughts leading to crop failure [6]. Narbon vetch has a wide ecological range from sub-humid to arid zones and has been grown as a forage crop for many years in the Southeastern Anatolia region of Turkey. Among the vetches of central Europe, the Mediterranean, the Near East, Ethiopia, central Asia, and India, common vetch and narbon vetch are significant fodder species. [7]. One of the oldest legume crops, bitter vetch (Vicia ervilia Willd), is native to the Mediterranean and Middle East. It has long been used to supplement animal feed with protein. However, it is currently regarded as a pulse of growing concern about global food security that has been overlooked or misused. An annual, self-pollinated plant called bitter vetch may withstand cold temperatures better than ordinary vetch, narbon vetch, or woolly-pod vetch. [8].

Cutting management is an important factor that influences the growth, yield, and quality of forage and seed of *Vicia spp*. The timing and frequency of cutting can affect the physiological and morphological characteristics of the plant, such as the number of branches, plant height, and leaf area, which in turn affect the forage yield and quality. Additionally, cutting management can also affect the seed yield and quality, as it can influence the number of pods per plant, seed weight per plant, and seed germination [9].

In Iraq, these three *Vicia* species, common vetch, narbon vetch, and bitter vetch are commonly cultivated for forage and seed production. However, little is known about the effects of cutting management on the development, fodder yield, seed yield, and yield mechanisms of these *Vicia* species in this region. Therefore, this research aims to evaluate the consequence of cutting two times on the growth, forage yield, seed yield, and yield components of three *Vicia* varieties in Sulaimani Governorate- Iraq. The findings of the study could provide insights into optimizing the growth and yield of these leguminous crops in the region.

Materials and methods

Field Experiment

The present research was conducted at Qlyasan Agricultural Research Station, College of Agricultural Sciences Engineering-University of Sulaimani, located in the Sulaimani governorate, during the winter season of 2021-2022. The experiment aimed to evaluate the performance of three different varieties of vetch, namely common vetch B1 (*Vicia sativa*), narbon vetch B21 (*Vicia narbonensis*), and bitter vetch B3 (*Vicia ervilia*) and two cutting dates: control (no cut); cut 1, (cut 80 days after sowing); and cut 2, (cut 100 days after sowing).

The first cut was executed when the plant height reached 35-40 cm, and the cutting height was maintained at 6-8 cm above ground level, following the guidelines suggested by Joel Bagg [10]. Sowing was carried out on 13/12/2021, adhering to the suggested seed rates of 120 Kg/ha for all three varieties, as per the recommendations of Tuna and Orak [11].

Each plot comprised of four rows, each measuring 2 meters in length, with a spacing of 0.30 m between the rows and 30 cm between plants in rows. The required agricultural practices were employed to ensure optimal growth and development of the vetch plants throughout the study period. The experiment was designed to provide valuable insights into the consequence of diverse varieties and cutting dates on the yield and quality of vetch, with the ultimate goal of promoting sustainable agriculture practices.

Plant Measurements

Plant measurements were taken to determine the yield traits and yield components of the vetch plants. The forage yield traits were evaluated in terms of fresh forage yield (ton/ha) and dry forage yield (ton/ha). The fresh forage weight was determined by measuring the weight (g/m2) of fresh forage and then converting it to kg/ha. The dry forage yield was calculated using the formula: Dry forage yield (ton/ha) = Dry Matter % x Fresh Forage Yield (kg/ha), where the dry matter percentage was determined by taking sub-samples of 100 g of forage and drying them in an oven at 65 C˚ for 72 hours.

The forage yield components were measured in terms of dry leaf weight %, dry stem weight %, and dry leaves/stem ratio %. The dry leaf weight was recorded by drying 100 g of forage in an oven at 65 C˚ for 72 hours and then measuring the weight of dry leaves. Similarly, the weight of fresh stems for 100 g of forage was recorded, and after drying in the oven at 65 C˚ for 72 hours, the weight of dry stems was determined. The ratio of dry leaf percent to dry stem percent was then calculated for each plot.

The yield characters of the vetch plants were determined by counting the number of pods per plant, measuring the 100-seed weight (gm), and recording the seed yield (kg/ha) and biological yield (kg/ha). The harvest index (HI) was also calculated as the ratio of seed yield to total biological yield of the plant, as per the method suggested by Rehman et al. [12]. The HI was calculated using the formula: Harvest Index = Seed yield (kg/ha) / Biological yield (ton/ha). These plant measurements provide essential data to evaluate the productivity and quality of the vetch plants and help in designing sustainable agriculture practices.

Experimental design and data analysis

The statistical analysis of the study involved a factorial experiment designed in a randomized complete block design (RCBD) with three replications. The experimental design followed the guidelines presented by Steel and Torrie [13]. The data collected from the experimental units were subjected to analysis of variance (ANOVA) to determine the main effects of the vetch varieties and cutting dates as well as their interactions.

To compare the means, the Least Significant Difference (LSD) test was performed at a significant level of 5%. The LSD test is a post-hoc test that allows for multiple pairwise comparisons of treatment mean to identify statistically significant differences between them. All possible comparisons among the means were carried out using this test. The statistical analysis of the data was performed using appropriate statistical software, and the results were presented in tables to facilitate interpretation and communication.

Results and Discussions

The results are presented in Table 1, showing the effects of three varieties of *Vicia* spp. on some forage yield and yield components. The leaf dry weight ranged from 5.783 to 6.527 g, with variety B1 producing the highest leaf dry weight. In terms of yield, variety B2 had the highest fresh forage yield at 19.352 ton/ha, while

variety B1 had the highest dry matter percentage at 12.368%.

The analysis of variance revealed a significant difference among the varieties for dry matter percentage, leaf dry weight and fresh yield ($p < 0.05$). However, there were no significant differences observed for stem dry weight, dry leaves/stem ratio and dry forage yield. The least significant difference (LSD) test showed that the difference in leaf dry weight and fresh yield between the varieties was significant at $p < 0.05$, respectively.

As a final point, we found that the three varieties of *Vicia spp*. differed in their forage yield and yield characters, with variety B1 showing superior performance in terms of leaf dry weight, and dry matter percentage, while variety B2 had the highest fresh forage yield. These findings suggest that the choice of variety could play a crucial role in maximizing forage yield and quality. In prior research conducted on different varieties of *Vicia spp*. In particular, notable variations demonstrated a remarkable advantage in terms of leaf dry weight and dry matter percentage, underscoring its potential for high-quality forage production [8]. These empirical findings underscore the significance of selecting the appropriate *Vicia spp*. variety as a strategic factor in optimizing both forage quantity and quality.

Table 1. Effects of Varieties on some growth forage yield for three varieties of *Vicia* spp.

varieties	Dry forage yield (ton/ha)	Dry matter %	Fresh forage yield (ton/ha)	leaf dry weight (gm)	Dry Leaves/Stem Ratio	Stem dry weight (g)
B1	2.195	12.368	17.338	6.527	0.355	5.543
B2	1.876	11.450	19.352	6.298	0.310	5.275
B3	1.940	10.475	17.273	5.783	0.325	5.677
LSD	ns	0.711 **	0.781 **	0.919**	ns	ns

B1- *Vicia sativa*, B2- *Vicia narbonensis*, B3 *vicia ervilia*

The outcomes existing in Table 2 show the mean values of dry forage yield, dry matter percentage, fresh forage yield leaf dry weight, dry leaves/stem ratio, and stem dry weight of the three varieties at two different cutting times (C1 and C2).

The results show that the fresh forage production varied in extremely significant ways., dry matter percentage, and dry forage yield between the two cutting times. For fresh forage yield, there was a significant increase in yield from C1 (17.139 ton/ha) to C2 (18.837 ton/ha) with a difference of 1.698 ton/ha. Similarly, there was a significant increase in dry matter percentage from C1 (9.699%) to C2 (13.163%), with a difference of 3.464%. This increase in dry matter percentage resulted in a significant increase in dry yield from C1 (1.741 kg/ha) to C2 (2.267 kg/ha), with a difference of 0.526 kg/ha. Moreover, the data showed that there were no significant differences between the three varieties of *Vicia spp*. in terms of stem dry weight, dry leaves/stem ratio, and leaf dry weight at both cutting times. Overall, these results suggest that delaying the cutting time for *Vicia spp*. can result in higher fresh and dry forage yields, as well as higher dry matter percentage [4]. However, further research is needed to investigate the effects of cutting times on other parameters such as nutritive value and digestibility, as well as the optimal cutting time for each variety.

Table 2. Effects of Cutting times on some growth forage yield for three varieties of Vicia spp.

Cutting time	Dry yield kg ha-1	Dry matter %	Fresh yield (ton/ha)	leaf dry weight (gm)	Dry Leaves/Stem Ratio	Stem dry weight (g)
C1	1.741	9.699	17.139	6.327	0.310	5.534

C2	2.267	13.163	18.837	6.079	0.350	5.462
LSD	0.396**	0.580**	0.638**	ns	ns	ns

Results in table 3 presented the effect of interaction on some forage yield for each of the three varieties (B1, B2, and B3) of *Vicia spp*. when grown under two different cutting treatments (C1 and C2). The analysis of variance indicated a significant interaction effect between the cutting treatment and variety for stem dry weight, fresh forage yield, and dry matter %. However, no significant interaction effect was observed for dry forage yield, dry leaves/stem ratio, and leaf dry weight ($P > 0.05$). The results indicate that the highest stem dry weight (6.79 g) was obtained when variety B2 was grown under cutting treatment C2, while the lowest stem dry weight (3.79 g) was obtained when variety B2 was grown under cutting treatment C1. For fresh forage yield, the highest yield (20.08 ton/ha) was obtained when variety B2 was grown under cutting treatment C2, while the lowest yield (15.616 ton/ha) was obtained when variety B1 was grown under cutting treatment C1. The least significant difference (LSD) test indicated that there were significant differences among the treatments ($P < 0.05$), except for dry forage yield, dry leaves/stem ratio, and leaf dry weight Overall, the results suggest that the interaction between cutting treatment and variety significantly influenced the forage yield of Vicia spp. In general, there was a significant difference in the forage yield attributes this result agrees with the result of [14].

Table 3. Effect of interaction on some growth forage yield for three varieties of Vicia spp**.**

Cutting*Varieties	Dry yield (ton/ha)	Dry matter %	Fresh yield (ton/ha)	leaf dry weight (gm)	Dry Leaves/Stem Ratio	Stem dry weight (g)
C1 B1	1.826	11.383	15.616	5.767	0.357	6.167
C1 B2	1.663	9.630	18.623	7.927	0.26	3.76
C1 B3	2.563	8.083	17.176	5.287	0.313	6.677
C2 B1	2.563	13.353	19.06	7.287	0.353	4.92
C2 B2	2.020	13.270	20.08	4.67	0.36	6.79
C2 B3	2.216	12.866	17.37	6.28	0.337	4.677
LSD	ns	1.005 **	1.105 **	ns	ns	1.391 **

The effects of three varieties of *Vicia spp*. on yield and yield characters were analyzed and are presented in Table 4. The results showed that there were no significant differences between the three varieties for some of the yield characters studied.

The LSD value for 100 seed weight was 0.838, indicating that the difference between the 100 seed weight of any two varieties must be greater than or equal to 0.838 to be considered statistically significant. The number of pods per plant was not significantly different among the three varieties.

The results suggest that variety B2 may be the most desirable for seed production, while variety B1 may be suitable for biomass production. However, additional research is required to confirm these results and assess other critical agronomic characteristics of these types.

Table 4: Effects of Varieties on yield and yield characters for three varieties of Vicia spp.

Varieties	No. of pods/ plant	100 seed weight (gm)	seed yield kgha-1	Biological yield kgha-1	Harvest index
B1	17.087	19.318	5889.198	14891.692	0.392
B2	17.506	20.679	6028.689	14442.556	0.370
B3	17.771	19.173	5669.354	14522.678	0.392
LSD	ns	0.838 **	ns	ns	ns

Results in table 5 presented the impact of cutting times on the yield and yield characteristics of three varieties of *Vicia spp.* Overall, the findings indicated significant differences between cutting times in some of the yield traits studied. Cutting time (Co) had the highest harvest index (0.43), biological yield (16056.946 kgha-1), and seed yield (6942.317 kgha-1). Cutting time C1 had a lower harvest index (0.39) and seed yield (5366.237 kgha-1) than Co, but still had a higher yield than C2. Cutting time C2 had the lowest harvest index (0.34) and seed yield (5278.688 kgha-1) of the three cutting times.

The 100 seed weight did not vary significantly among the cutting times, indicating that it was not affected by the time of cutting. The LSD value for biological yield was 1674.394, which meant that the difference between the biological yields of any two cutting times had to be greater than or equal to 1674.394 to be considered statistically significant. The LSD value for seed yield was 481.936, indicating that the difference between the seed yield of any two cutting times had to be greater than or equal to 481.936 to be considered statistically significant. The number of pods per plant differed significantly among the cutting times, with cutting time Co having the highest number of pods per plant (18.976) compared to C1 (16.920) and C2 (16.468). Orak and Nizam [15] found that number of pods in common vetch ranged from 7.45 to 18.75. The outcomes suggest that cutting time C2 may be the most favorable for *Vicia spp*. production due to its biological yield, seed yield, and number of pods per plant. However, additional research is required to validate these conclusions and assess other vital agronomic characteristics of *Vicia spp*. under different cutting times.

Table 5: Effects of Cutting times on yield and yield characters for three varieties of *Vicia spp*.

Cutting	No. of pods/ plant	100 seed weight (gm)	seed yield kgha-1	Biological yield kgha-1	Harvest index
C1	18.976	19.990	6942.317	16056.946	0.43
C2	16.920	19.823	5366.237	13835.167	0.39
C3	16.468	19.357	5278.688	13964.814	0.34
LSD	0.880 **	ns	481.936 **	1674.394 *	ns

Results in Table 6 displays the outcomes of the examination of the impact of the combination of cutting times and varieties on the yield and yield characteristics of Vicia spp. The results revealed that the interaction effect was statistically significant ($p < 0.05$) for most of the parameters investigated, except for harvest index and biological yield, which were not statistically significant. The highest seed yield was obtained from C1B2 (7638.26 kg/ha), while the lowest was obtained from C2B3 (4840.773 kg/ha). The 100 seed weight was highest in C2B2 (21.466 gm) and lowest in C3B3 (18.666 gm). The number of pods per plant was highest in C1B1 (19.286) and lowest in C3B1 (14.73). The LSD values for the significant parameters were 0.195*, 1.451*, and 1.525** for seed yield, 100 seed weight, and number of pods per plant, respectively.

The results indicate that the cutting time and variety had a significant effect on the yield and yield characters of *Vicia spp*., and the highest values were obtained from the combination of C1B1 and C1B2. The results are in line with [16] and its confirm that the interaction between different varieties and cutting times can have a significant impact on the yield and yield characters of *Vicia spp*.

Table 6: The effect of interaction yields and yield characters for three varieties of Vicia spp.

Cutting*Varieties	No. of pods/ plant	100 seed weight (gm)	seed yield kgha-1	Biological yield Kg ha -1	Harvest index
C1 B1	19.286	20.440	6361.443	16314.543	0.386
C1 B2	19.463	20.500	7638.26	16020.926	0.473
C1 B3	18.176	18.98	6827.246	15835.366	0.426
C2 B1	17.243	18.130	5761.57	13949.866	0.406
C2 B2	16.94	21.466	5496.366	13589.733	0.400
C2 B3	16.576	19.873	4840.773	13965.900	0.356
C3B1	14.73	19.383	5544.58	14410.666	0.383
C3B2	16.113	20.02	4951.44	13717.008	0.236
C3B3	18.560	18.666	5340.043	13766.766	0.393
LSD	1.525 **	1.451 *	0.195 *	ns	ns

Conclusion

This study found that the three varieties of *Vicia spp* differed significantly in forage yield and yield characters. Variety B1 performed better in leaf dry weight and dry matter percentage, while B2 had the highest fresh yield. Variety B2 is recommended for seed production, while B1 may be suitable for biomass production. Cutting time C1 was found to be the most favorable for *Vicia spp.* production. However, further research is needed to confirm these findings and investigate other important agronomic traits, such as nutritive value and digestibility, as well as the optimal cutting time for each variety. Careful consideration of variety and cutting time is essential for maximizing forage yield and quality in Vicia spp. production.

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تأثير أوقات القطع على إنتاج العلف لثلاثة أصناف من الكشون (Vicia Spp.) في محافظة السليمانية

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الملخص

خلال فصل الشتاء 2021–2022 ، أجريت تجربة ميدانية في مواقع قليسان في محافظة السليمانية. هدفت هذه الدراسة إلى فحص تأثير تواريخ القطع على محصول الأعلاف والبذور ، وكذلك على مكونات أصناف Vicia المختلفة. تم تصميم التجربة كتصميم عاملي وأجريت باستخدام تصميم كتلة عشوائية بالكامل. تم إجراء التحليل الإحصائي باستخدام اختبار الفرق الأقل أهمية (L.S.D) بمستوى معنوي قدره 5٪. كانت أصناف Vicia الثلاثة التي تم اختبارها هي البيقية الشائعة (*Vicia sativa*) ، والبيقية المخدرة (*Vicia narbonensis*)، والبيقية المرة .(*Vicia ervilia*) تم استخدام تاريخين للقطع ، وهما التحكم Co) ، بدون قطع (، والقطع 1 (80 يوما بعد البذر) ، والقطع 2 (20 يوما بعد القطع الأول). كشفت نتائج هذه الدراسة أن التفاعل بين البيقية الشائعة والقطع بعد 80 يوما من البذر أنتج أعلى قيم لسمة النسبة المئوية للمادة الجافة. وفي الوقت نفسه ، أعطى التفاعل بين البيقية المخدرة والقطع بعد 20 يوما من القطع الأول أعلى قيم للمحصول الطازج (طن / هكتار) والوزن الجاف للساق (جم). تم الحصول على القيم القصوى للصفتين "عدد القرون لكل نبات" و "محصول البذور (كجم / هكتار)" من خلال التفاعل بين المعالجة الضابطة والبيقية النارية. ومع ذلك ، فإن التفاعل بين القطع في 80 يوما بعد البذر والبيقية المخدرة أنتج أعلى قيم لسمة وزن 100 بذرة (جم). قد يفسر التباين في الظروف المناخية بين المواسم هذه النتائج.

الكلمات المفتاحية: البيقية الشائعة، البيقية النربون، البيقية المرة، محصول البذور، القطع، إنتاجية العلف