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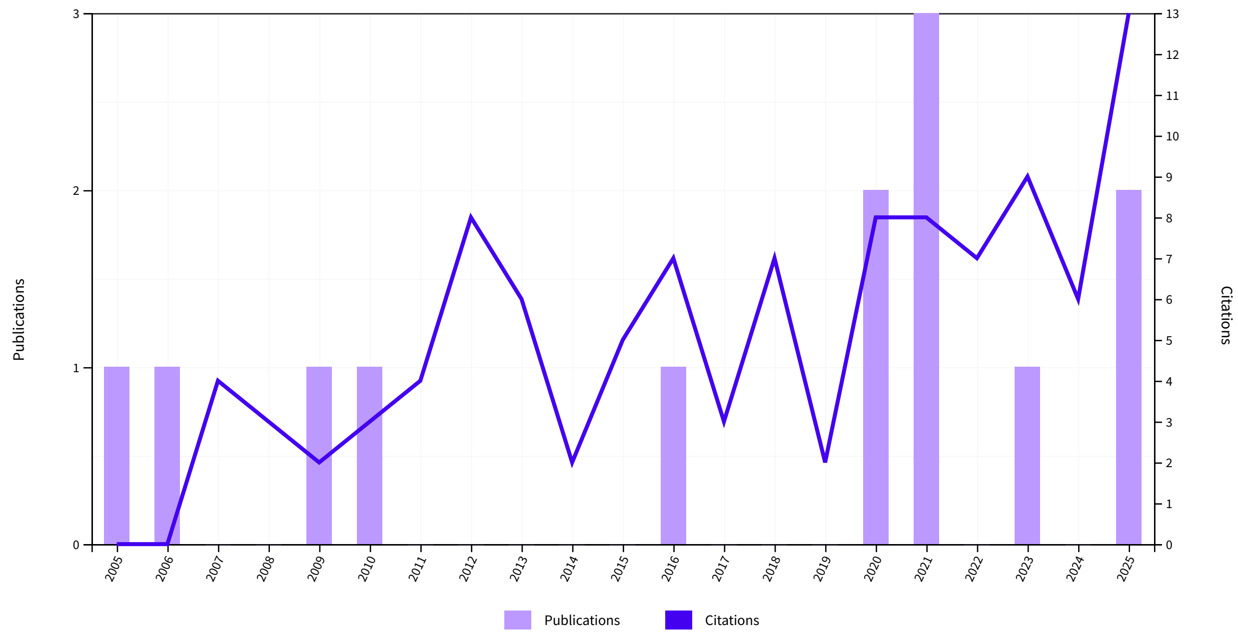

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2	**Oats (*Avena sativa*) - common vetch (*Vicia sativa*) mixtures grown on a low-input basis for a sustainable agriculture** Erol, A; Kaplan, M and Kizilsimsek, M 2009 | TROPICAL GRASSLANDS 43, pp.191-196	3	3	0	2	3	1.53	26
3	**Relationship Among Silage Micro Flora and Their Effects on Silage Fermentation and Quality** Kizilsimsek, M; Erol, A; (...); Katranci, B 2016 | KAHRAMANMARAS SUTCU IMAM UNIVERSITY JOURNAL OF NATURAL SCIENCES 19(2), pp.136-140	0	2	4	1	0	1.2	12
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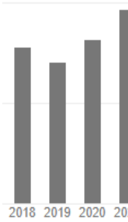

BAŞLIK	ALINTI YAPANLAR	YIL
Effect of maturity stage on chemical composition, in vitro and in situ dry matter degradation of tumbleweed hay (Gundelia tournefortii L.) A Kamalak, O Canbolat, Y Gurbuz, A Erol, O Ozay Small Ruminant Research 58 (2), 149-156	135	2005
Oats (Avena sativa)--Common vetch (Vicia sativa) mixtures grown on a low-input basis for a sustainable agriculture A Erol, M Kaplan, M Kizilsimsek TG: Tropical Grasslands 43 (3), 191	105	2009
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Isparta-Darıderesi Havzası topraklarında erozyona duyarlılığın arazi kullanım şekillerine bağlı değişimi A Erol, AA Babalık, K Sönmez, N Serin Süleyman Demirel Üniversitesi Orman Fakültesi Dergisi, 21-36	24	2009

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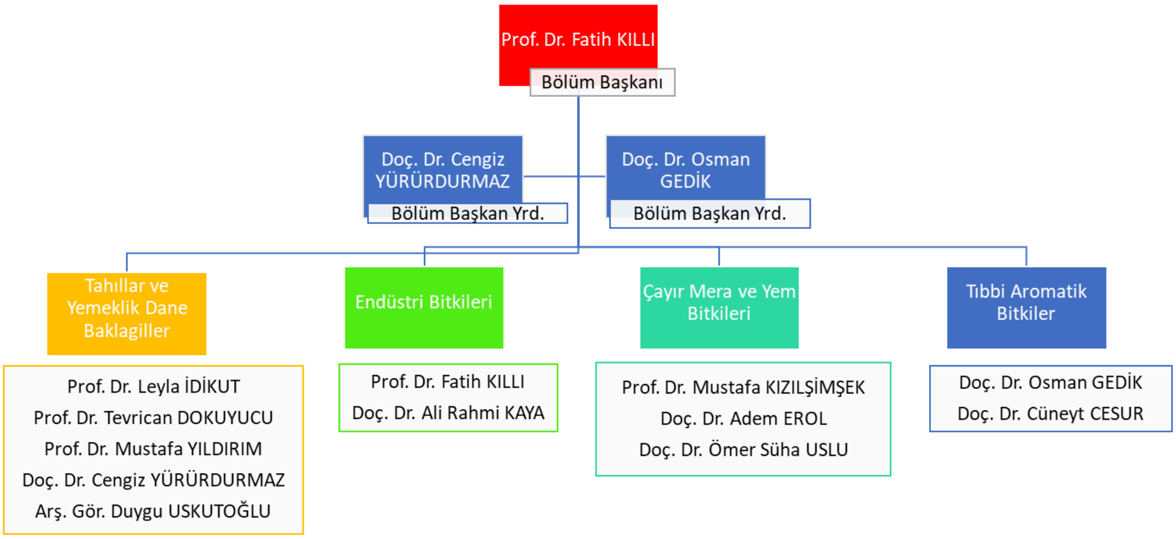

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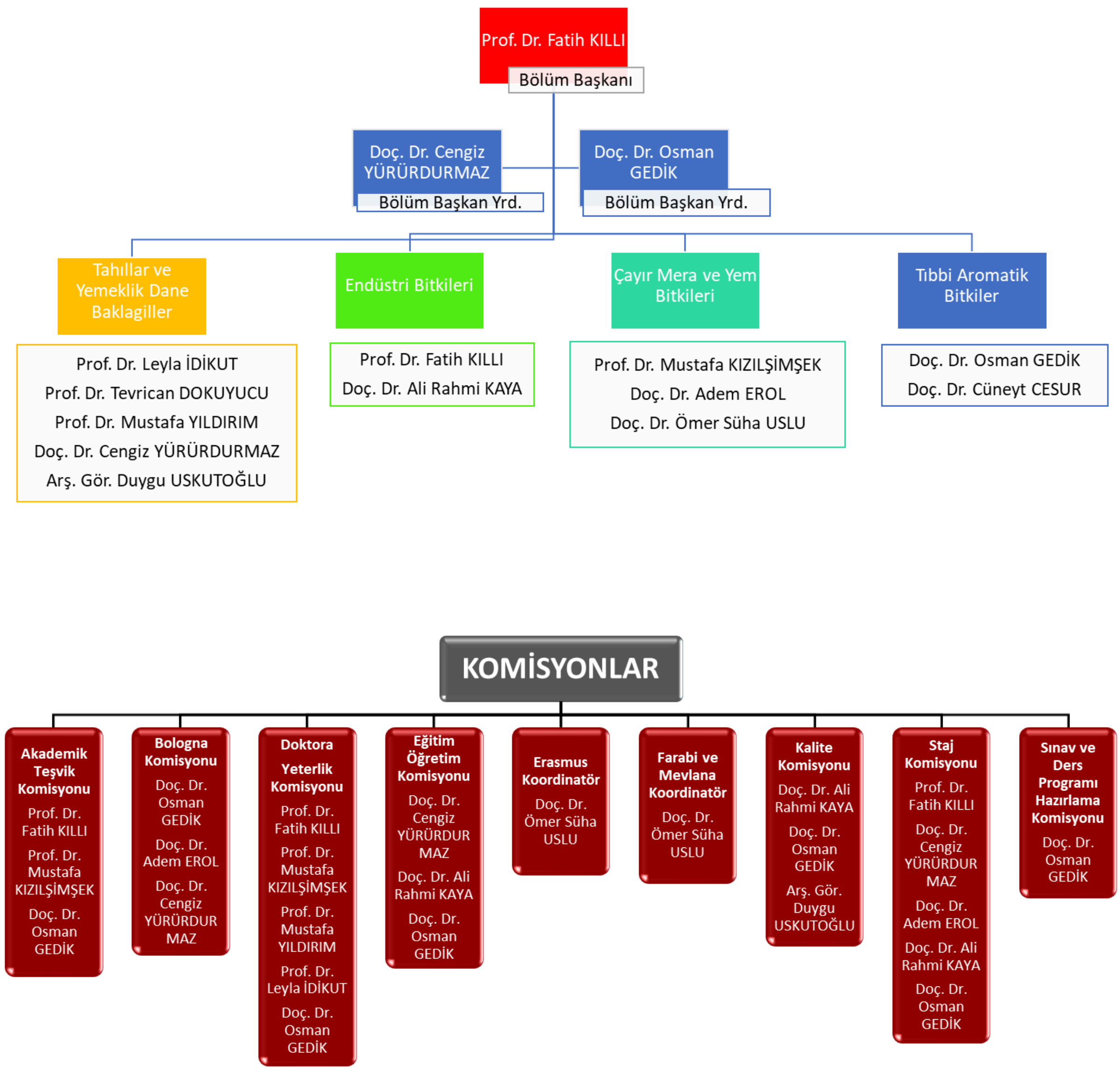

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Effects of Different Irrigation Water Sources Contaminated with Heavy Metals on Seed Germination and Seedling Growth of Different Field Crops

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Abstract: Irrigation water quality is of critical importance for optimum crop yield of economically important field crops in the Kahramanmaraş plains. A preliminary ecotoxicological assessment is necessary before large-scale irrigation. Therefore, this study aims to evaluate the quality of irrigation water supplied from different water sources (Karasu, Erkenez, and Oklu streams on the Aksu River and Sır Dam) and the effects on the seed germination and early seedling growth of different field crops (wheat, alfalfa, ryegrass, and maize) irrigated with this water. For this, in order to evaluate the effects on seed germination and early growth parameters of forage crop seedlings, a Petri dish germination test was carried out with four replications using a completely randomized design (CRD). Before the germination assay, heavy metal concentrations including copper (Cu), iron (Fe), lead (Pb), chromium (Cr), arsenic (As), nickel (Ni), and cadmium (Cd) were analyzed in water samples obtained from different water sources. In all water samples used for the experiment, Cu concentrations exceeded the acceptable limit of 0.2 mg L^{-1}. The Cu levels found were 0.98 mg L^{-1} in Karasu (KC), 1.627 mg L^{-1} in Oklu (OC), 0.945 mg L^{-1} in Erkenez (EC), and 1.218 mg L^{-1} in Sır Dam (SD) waters. Additionally, Fe exceeded the limit only in KC, while Cd surpassed the permissible levels in EC and SD water samples. Seeds exposed to different water treatments were germinated in a climate chamber at 20 ± 1 °C. Over two weeks, daily germination and seedling growth parameters were measured. The results indicated that higher heavy metal concentrations in irrigation water led to a decline in seed germination rates and adversely impacted early seedling growth. Notably, water from Karasu Creek exhibited the most significant negative impact on all germination and growth parameters in the tested crops, especially due to Cu and Fe metal toxicity. Additionally, ryegrass seeds were most affected by these irrigation waters. This study highlights the importance of using uncontaminated quality irrigation water for optimal crop production by quantifying its impact, such as the percentage of decrease in germination or seedling growth.

Keywords: sustainable irrigation; water quality; heavy metals; toxicity; seedling development; plant growth

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1. Introduction

In Türkiye, as in many other countries, field crops are essential for both domestic consumption and export markets. Their economic, nutritional, and ecological importance makes them a cornerstone of sustainable agricultural systems [1,2]. Wheat, alfalfa, ryegrass, and corn are globally significant field crops with high nutritional value, contributing significantly to food security, livestock feed, and industrial raw materials serving as staple foods for much of the world's population [3]. Among them, wheat and corn dominate global crop production [4]. The seeds of wheat, rye, and corn are utilized in various industries for flour, malt, bread, pasta, and cereals, while their stalks serve as livestock feed [4,5]. Alfalfa, on the other hand, is primarily used as hay for animal feeding. Wheat, a key source of protein and starch, contributes 20–30% of daily caloric intake in many societies [6]. However, these widely cultivated crops are increasingly exposed to abiotic stressors such as irregular rainfall, rising temperatures, and prolonged drought due to global climate change, leading to significant yield losses [7,8].

Germination is the critical physiological process by which a seed transitions into a seedling under favorable conditions [9]. It involves metabolic activation, culminating in the emergence of the radicle and shoot. This process comprises a cascade of biological and biochemical events, making germination and early seedling development crucial stages in crop establishment [10]. Germination begins with water absorption by the dormant seed, initiating embryonic axis elongation and radicle emergence [11]. This process involves tightly regulated morphogenetic and physiological mechanisms, including energy transfer, nutrient uptake, and biochemical changes [12,13]. The rupture of the seed coat enables root and shoot emergence, activating seed respiration [13,14]. Physically, germination progresses in two distinct phases: endosperm rupture and radicle protrusion, followed by micropylar endosperm degradation [15]. Enzymatic activity during these stages is highly sensitive to temperature, nutrient availability, and water status [16]. Therefore, abiotic factors such as oxygen content, temperature, light, pH, water availability, and water quality in the germination environment significantly affect seed physiology and seed–soil interactions [9,17]. In addition, genetic variability determines the response of seeds to external stress factors, shaping species distribution and productivity [13,17].

Water is indispensable for germination, facilitating protoplasmic hydration, oxygen dissolution, and seed coat softening to enhance permeability [13,16]. While water deficiency negatively impacts germination rates [7,18], optimal water supply enhances germination success [19]. Both water quantity and quality play pivotal roles in seed imbibition and subsequent metabolic processes [16–19]. Water activates enzymes responsible for endospermic material degradation, transport, and utilization [20]. However, water stress impairs enzymatic activity, disrupts carbohydrate metabolism, reduces cellular water potential, and alters seed hormonal balance, thereby hindering germination and seedling establishment [21].

The textile industry is a major source of heavy metal contamination in Kahramanmaraş. Textile finishing plants consume significant amounts of water—approximately 95–400 L per kilogram of textile product. This water is typically drawn from rivers and discharged back after use. Beyond its high water consumption, the industry extensively uses chemicals, including dyes and auxiliary agents. As a result, industrial effluents introduce chemical and heavy metal contaminants into irrigation waters [22–24]. In Kahramanmaraş, textile wastewater is discharged into the Aksu River, which ultimately flows into Sır Dam. This causes toxic heavy metals to accumulate in the environment and reach hazardous levels in water resources, posing serious ecological risks [25]. This discharge, combined with domestic waste, significantly pollutes the dam water. The Aksu River and its tributaries carry heavy loads of industrial and domestic waste, yet their waters are frequently used for agricultural irrigation in the region.

The most significant effects of heavy metals on the biological cycle occur in plants [26]. The toxicity levels of plants are an especially key limiting factor for seed germination and early seedling growth [25]. Also, they have an important impact on plant growth, biomass production, flowers, fruit set, yield, and product quality [27,28]. Furthermore, heavy metals have negative effects on various physiological processes of the plant at the intracellular level such as disrupting photosynthesis, the nitrogen cycle, and binding, thus decreasing chlorophyll amounts, leading to deterioration in enzyme systems and inhibiting the uptake of useful elements [29,30]. Similarly, there are various studies on the effects of heavy metals on the development of radicle, hypocotyl, epicotyl, plumule, and seedlings in germination and early development stages of different field and horticultural crops [31–35]. While some heavy metals, especially Cr, Cd, Mn, Cu, Pb, and Zn, do not cause problems in plant and animal bodies at low doses, they do cause toxic effects such as metabolic disorders and growth inhibition at concentrations above the threshold values [36,37]. Although trace metals that have toxic effects on some plants have been studied for many years, there is a strong need in the literature to fully determine their phytotoxic effects [38]. For example, it has been reported that the growth of wheat (*Triticum aestivum* L.) is reduced by 50% at 0.5 µM Cu and 30 µM Cu concentrations [39,40]. However, there is no appropriate information about other crops.

Germination is a crucial phase in plant production, as plants cannot develop or grow without it. As the most vulnerable stage in a plant's life cycle, germination requires optimal environmental conditions to ensure successful seedling establishment. Therefore, preliminary laboratory experiments on germination and early seedling growth are regarded as among the simplest, most accurate, convenient, and cost-effective biological monitoring methods for assessing the tolerance of different plant species and varieties to environmental changes in heavy metal concentrations [41,42].

The use of alternative water sources in agriculture can help reduce pressure on freshwater supplies, particularly in regions experiencing summer drought. Given reports of pollution from nearby factories, it is essential to assess the suitability of Aksu Stream and Sır Dam waters for agricultural irrigation, especially as drought conditions intensify. However, these water sources may contain high concentrations of cations and anions, which can lead to morphological and physiological disorders in plants, such as reduced germination, stunted root growth, and overall developmental inhibition. The effects of irrigation water on seed germination and early growth parameters vary depending on water quality, heavy metal availability, and plant species, making it crucial to evaluate these differences for sustainable agricultural production. This study aims to: i) Analyze the chemical properties of water from the dam basin and its tributaries used for irrigation; ii) Assess the impact of different water sources on the germination and early seedling development of key regional crops—wheat, alfalfa, ryegrass, and corn—due to their economic and ecological significance. The findings provide critical insights into the impact of alternative irrigation sources on seed germination and early growth, contributing to more sustainable agricultural practices.

2. Materials and Methods

2.1. Study Sites and Crop Materials

This study was carried out from 1 March to 30 July 2017 in the laboratory of the Department of Field Crops of the Faculty of Agriculture, Kahramanmaraş Sutcu Imam University. Irrigation waters containing heavy metals were collected from four different sources of the Aksu River (Erkenez Creek, Oklu Creek, and Karasu Creek) and Sır Dam

Ponds located in Kahramanmaraş, Türkiye. The seeds of four field crops—wheat, clover, ryegrass, and corn—widely cultivated in the Kahramanmaraş region, particularly near the dam, were used as test plants. These crops were selected due to their extensive use by local farmers and their commercial importance. The seeds were purchased from seed production enterprises.

2.2. Preparations and Analysis of Water Samples

Images of the locations where water samples were collected are shown in Figure 1, and their geographical coordinates are provided in Table 1. Water samples were collected as per the standard method of sampling techniques [43]. Creek water samples were taken from the middle part of the stream which was flowing fastest and not stagnant, at early morning irrigation time. The mixture was prepared by taking water from the Sır Dam from three different depths: the deepest part of the dam, the middle part, and the surface. The tap water used as a control was collected after the faucet was allowed to run for 30–60 seconds. The water samples were taken in 1 L plastic bottles, filtered, and solid impurities were removed. These water samples were used for the irrigation of crop seeds. The concentration of some pollutant heavy metals Cu, Fe, Ni, Pb, Cr, As, and Cd in the initial water samples was determined by Inductively Coupled Plasma Optical Emission Spectroscopy (Perkin Elmer ICP-OES-6000, Agilent, Santa Clara, CA, USA) at ÜSKİM (University, Industry, Public Cooperation Development, Application and Research Center).

Figure 1. View of the study area (**A**) Oklu Creek, (**B**) Karasu Creek, (**C**) Erkenez Creek, (**D**) Sır Dam ((**A**–**C**) photo taken by Uslu; (**D**) photo taken by URL (accessed on 10 March 2025) https://commons.wikimedia.org/wiki/File:S%C4%B1r_Baraj%C4%B1_-_Kahramanmara%C5%9F_03.jpg#filelinks).

Table 1. The geographical location of water sample collection points.

	Karasu Creek	Erkenez Creek	Oklu Creek	Sır Dam
Latitude	37°31′3.45″ K	37°32′25.56″ K	37°33′49.39″ K	37°34′30.35″ K
Longitude	36°56′0.85″ D	36°55′13.30″ D	36°54′42.67″ D	36°48′6.19″ D

The pollution level of the water samples used for irrigation was assessed considering the maximum permissible limits, summarized in Table 2. Heavy metal concentrations below or equal to these values in the irrigation waters do not pose any toxic effects for up to 24 years on clayey soils with a pH of 6.0–8.5.

Table 2. Maximum permissible limits of heavy metals in irrigation waters [44].

Elements	Maximum Possible Amount per Unit (kg ha^{-1})	Allowable Maximum Concentrations	
		Boundary Values in Cases of Continuous Irrigation for All Kinds of Soil (mg L^{-1})	When Watering Less than 24 Years in Clay Soils with a pH Value Between 6.0–8.5 (mg L^{-1})
Arsenic (As)	90	0.1	2.0
Cadmium (Cd)	09	0.01	0.05
Chrome (Cr)	09	0.1	1.0
Copper (Cu)	190	0.2	5.0
Iron (Fe)	4600	5.0	20.0
Lead (Pb)	4600	5.0	10.0
Nickel (Ni)	920	0.2	2.0

2.3. Experimental Procedure and Measurement

The seeds were germinated in water samples obtained from four different sources (Table 1) in comparison to tap water (control). Before sowing, the seeds were kept in a 5% NaClO (sodium hypochlorite) solution for 5 m and sterilized and rinsed with tap water [42]. After lining the Petri dishes with filter paper (Cytiva Whatman 589/1 Circles—90 mm), 25 seeds were sown using 20 mL of irrigation water sample in each Petri dish according to the assigned treatments in a completely randomized design (CRD) with four replicates. The seeds were germinated in a room-temperature climate of 20 ± 1 °C. The seed germination was monitored daily for 14 days. Germination rate, root length, plumage length, seedling length, seedling age, weight, seedling dry weight, and seedling vigor index values were measured daily. Germination percentage was calculated as the ratio between the number of germinated seeds and the total number of seeds. Seedling length, radicle, and plumule were separated and measured with a ruler. The fresh and dry biomass was determined gravimetrically by weighing before and after drying (at 80 °C for 24 h) [45]. The vigor index was calculated by multiplying the seedling length by the germination percentage, as shown in Equation (1).

$$\text{Vigor index (VI)} = \text{Seedling length} \times \text{Germination percentage} \quad (1)$$

2.4. Statistical Analysis

All obtained experimental results were statistically analyzed using the SAS Statistical Program Version 9.1 [46]. An LSD test was used to reveal the differences between the averages of different crops, different irrigation waters, and their interactions [47].

3. Results

In this study, heavy metal concentrations in all irrigation water samples were measured and compared with the maximum allowable limits (Tables 2 and 3). The results show that Cu levels in Karasu Creek irrigation water are approximately 5 times higher than the permissible limit, while Fe levels are 3.7 times higher (Table 2). Similarly, Cu concentrations were found to be 8 times higher in Oklu Creek, 5 times higher in Erkenez Creek, and 6 times higher in Sır Dam compared to the permissible limits. In Sır Dam water samples, high concentrations of Fe were also obtained, but these values were only 1–2 times higher than the maximum permissible limit. Cd concentrations were extremely high in Erkenez Creek and Sır Dam, 20 times and 23 times above the permissible limit, respectively (Table 3).

Table 3. Heavy metal concentrations in irrigation waters used in this study.

	AMC	KC	OC	EC	SD
Cu (mg L^{-1})	0.2	**0.98**	**1.627**	**0.945**	**1.218**
Fe (mg L^{-1})	5.0	**18.69**	0.555	2.395	**8.89**
Pb (mg L^{-1})	5.0	0.00015	0.00056	4.5	0.013
Cr (mg L^{-1})	5.0	0.097	0.00038	0.02	0.00013
As (mg L^{-1})	1.0	0.206	0.171	0.165	0.132
Ni (mg L^{-1})	0.5	0.00328	0.04	0.00067	0.00067
Cd (mg L^{-1})	0.005	0.00068	0.00069	**0.099**	**0.115**

Notes: AMC: Allowable Maximum Concentration; KC: Karasu Creek; OC: Oklu Creek; EC: Erkenez Creek; SD: Sır Dam; Red colors show higher concentrations.

Based on these results, it can be stated that the analyzed water samples have a high content of Cu, Fe, and Cd and, therefore, their use as irrigation water can affect crop growth.

In order to determine how plant growth is influenced by irrigation water with high levels of such heavy metals, some important parameters were determined in each case. The mean values of all the parameters are shown in Table 4. The obtained results of statistical analysis indicate that all considered parameters were significantly affected by the irrigation of plants with water with a high content of heavy metals.

Table 4. The Average GR, RL, PL, SL, SFW, SDW, and VI Values for Species and Irrigation Water.

		GR (%)	RL (cm)	PL (cm)	SL (cm)	SFW (g)	SDW (g)	VI
		**	**	**	**	**	**	**
Species	Wheat	**98 a**	**16.96 a**	**11.63 a**	**28.58 a**	1.68 b	0.34 c	**2812 a**
	Alfalfa	**96 a**	9.38 c	7.25 b	16.64 b	1.46 b	0.47 b	1598 b
	Ryegrass	78 b	9.31 c	6.97 b	16.28 b	0.28 c	0.04 d	1352 c
	Corn	72 b	11.36 b	6.63 b	17.99 b	**4.66 a**	**0.62 a**	1322 c
	LSD	6.97	1.76	0.88	2.17	0.68	0.09	232.60
		**	**	**	**	ns	**	**
Irrigation waters	Control	**95 a**	**11.50 a**	**8.16 a**	**19.66 a**	2.17	**0.42 ab**	**1874 a**
	Erkenez Creek	**87 a**	**12.11 a**	**8.55 a**	**20.67 a**	2.02	**0.50 a**	**1841 a**
	Oklu Creek	**89 a**	**13.14 a**	**8.55 a**	**21.69 a**	2.45	0.34 bc	**1967 a**
	Karasu Creek	71 b	8.46 b	6.60 b	15.06 b	1.61	0.27 c	1177 b
	Sır Dam	**87 a**	**13.55 a**	**8.73 a**	**22.28 a**	1.84	0.31 bc	**1997 a**
	LSD	7.98	1.97	0.98	2.43	0.76	0.11	260.10
	Mean	86	11.75	8.12	19.87	2.02	0.37	1771
	CV %	12.77	23.64	17.04	17.24	53.28	41.27	20.74

Notes: ** Significant at $p < 0.01$; ns: not significant; GR: Germination Rate; RL: Radicle length; PL: Plumule Length; SFW: Seedling Fresh Weight; SDW: Seedling Dry Weight; VI: Vigor Index (Different letters stand for statistically significant differences at $p < 0.05$ (Fisher LSD test)). Bold colors show higher values.

3.1. Germination Rate (%)

In terms of germination rate, cultivar, irrigation water, and cultivar × irrigation water interaction were statistically significant (Table 4 and Figure 2). The highest germination rate was seen in wheat with 98.20%, followed by clover with 96%. The lowest germination rate was seen in corn at 72%. The highest germination rate in terms of irrigation water was obtained from the control application at 95.25%, and the lowest germination rate was obtained from KC water at 71.75%. The highest germination rate in terms of cultivar × irrigation water interaction was seen in alfalfa irrigated with OC water at 100%, followed by wheat irrigated with SD and OC water at 99%. The lowest germination rate was 44% for Italian ryegrass irrigated with KC water (Figure 2).

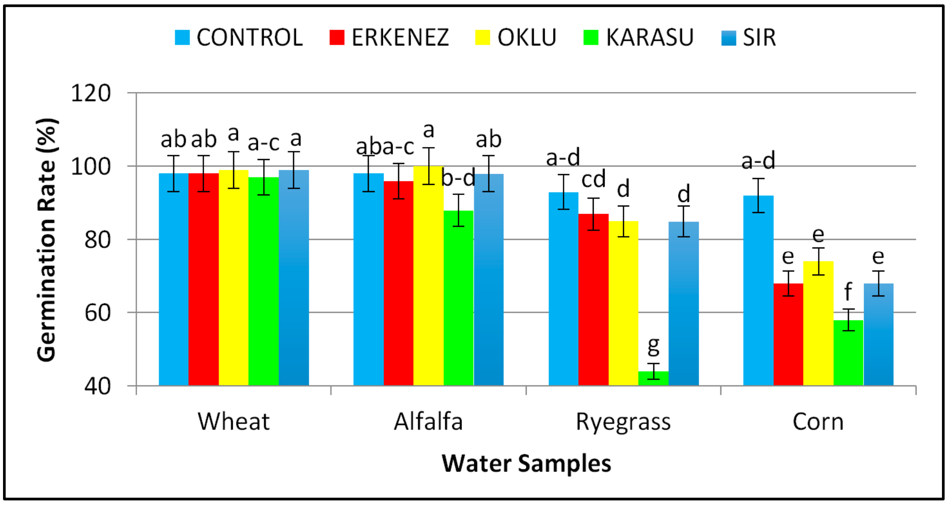

Figure 2. Effects of different irrigation water on seed germination rate. (Error bars show ± standard errors. Different letters stand for statistically significant differences at $p < 0.05$ (Fisher LSD test)).

3.2. Radicle Length (cm)

In terms of radicle length, the effects of cultivar, irrigation water, and the interaction between cultivar and irrigation water were statistically significant (Table 4 and Figure 3). The highest radicle length was observed in wheat, with 16.95 cm, followed by corn at 11.31 cm. The lowest radicle length was recorded in ryegrass, at 9.31 cm. Regarding irrigation water, the highest radicle length (13.54 cm) was observed with SD irrigation water application, while the lowest (8.46 cm) was associated with KC water. For the cultivar × irrigation water interaction, wheat irrigated with OC water showed the highest radicle length at 20.19 cm, followed by wheat irrigated with SD water at 19.46 cm. The lowest radicle length (8.41 cm) was recorded in alfalfa irrigated with OC water (Figure 3).

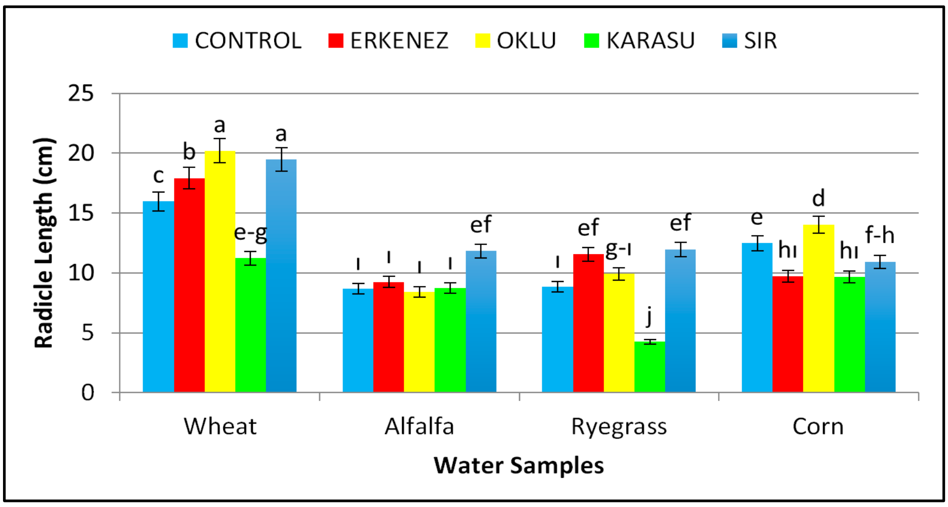

Figure 3. Effects of different irrigation waters on radicle length of seeds (Error bars show ± standard errors. Different letters stand for statistically significant differences at $p < 0.05$ (Fisher LSD test)).

Statistically, the lowest radicle lengths were detected in all different plant species irrigated with KC water.

3.3. Plumule Length (cm)

Data regarding plumule length, cultivar, and irrigation water were statistically significant; cultivar × irrigation water interaction was non-significant (Tables 4 and 5). The highest plumule length was seen in wheat at 11.63 cm, followed by alfalfa at 7.25 cm. The lowest plumule length was seen in ryegrass at 6.63 cm. The highest and lowest plumule length values were found to be consistent with the radicle length values. In terms of irrigation water, the highest plumule length value was observed with SD irrigation water application at 8.73 cm, and the lowest plumule length of 6.60 cm was observed with KC water. The highest plumule length was seen in wheat irrigated with OC water, at 12.83 cm. The lowest plumule length was observed in ryegrass irrigated with KC water, at 4.70 cm (Table 4).

Table 5. The Average GR, RL, PL, SL, SFW, SDW, and VI Values for Interactions between Species and Irrigation Water.

		GR (%)	RL (cm)	PL (cm)	SL (cm)	SFW (g)	SDW (g)	VI
		**	*	ns	ns	ns	**	*
Wheat	Control	98 ab	15.99 c	11.03	27.01	1.51	0.34 de	2643 c
	Erkenez Creek	98 ab	17.93 b	11.63	29.56	1.62	0.36 de	2899 b
	Oklu Creek	**99 a**	**20.19 a**	12.83	33.02	2.04	0.32 e	**3266 a**
	Karasu Creek	97 abc	11.22 efg	10.76	21.98	1.55	0.34 de	2143 d
	Sır Dam	**99 a**	**19.46 a**	11.88	31.34	1.67	0.35 de	**3107 a**
Alfalfa	Control	98 ab	8.69 i	7.00	15.68	1.37	0.65 bc	1538 f
	Erkenez Creek	96 abc	9.23 i	8.06	17.31	1.83	**1.04 a**	1659 ef
	Oklu Creek	**100 a**	8.42 i	6.57	14.98	1.34	0.23 ef	1498 fg
	Karasu Creek	88 bcd	8.73 i	6.18	14.91	1.09	0.17 ef	1306 gh
	Sır Dam	98 ab	11.83 ef	8.48	20.30	1.67	0.27 e	1988 d
Italian Ryegrass	Control	93 abcd	8.86 i	7.65	16.51	0.33	0.04 f	1536 f
	Erkenez Creek	87 cd	11.56 ef	7.39	18.95	0.26	0.04 f	1653 ef
	Oklu Creek	85 d	9.91 ghi	7.40	17.31	0.36	0.05 f	1467 fg
	Karasu Creek	44 g	4.25 j	4.70	8.95	0.21	0.03 f	429 j
	Sır Dam	85 d	11.98 ef	7.69	19.67	0.23	0.04 f	1672 ef
Corn	Control	92 abcd	12.48 e	6.97	19.45	5.48	0.65 bc	1778 e
	Erkenez Creek	68 e	9.71 hi	7.14	16.85	4.36	0.59 bc	1149 h
	Oklu Creek	74 e	14.03 d	7.41	21.44	6.08	0.76 b	1636 ef
	Karasu Creek	58 f	9.65 hi	4.77	14.41	3.58	0.53 cd	827 i
	Sır Dam	68 e	10.93 fgh	6.87	17.80	3.78	0.58 bc	1218 h
	LSD	9.09	1.37	0.46	1.60	0.38	0.18	186.90
	Mean	86	11.75	8.12	19.87	2.02	0.37	1771
	CV %	12.77	23.64	17.04	17.24	53.28	41.27	20.74

Notes: ** Significant at $p < 0.01$; * Significant at $p < 0.05$ ns: not significant; GR: Germination Rate; RL: Radicle length; PL: Plumule Length; SFW: Seedling Fresh Weight; SDW: Seedling Dry Weight; VI: Vigor Index (Different letters stand for statistically significant differences at $p < 0.05$ (Fisher LSD test)).

3.4. Seedling Length (cm)

Seedling length was significantly affected by cultivar and irrigation water, while their interaction was non-significant (Tables 4 and 5). Wheat exhibited the highest seedling length (28.58 cm), followed by corn (17.99 cm). The lowest seedling length was seen in Italian ryegrass, 16.28 cm. Among irrigation water sources, the highest seedling length was recorded with SD water (22.28 cm), while the lowest was observed with KC water (15.06 cm). The highest seedling length in terms of cultivar × irrigation water interaction was observed in wheat irrigated with OC water, at 33.02 cm, followed by wheat irrigated with SD water, at 31.34 cm. The lowest seedling length was observed in Italian ryegrass irrigated with KC water, at 8.94 cm (Table 4).

3.5. Seedling Fresh Weight (g)

Regarding seedling fresh weight, only differences between cultivar means were statistically significant (Table 4). Corn had the highest seedling fresh weight (4.65 g), followed by wheat (1.67 g). The lowest seedling fresh weight was observed in Italian ryegrass at 0.27 g. In terms of irrigation water, the highest seedling fresh weight value resulted from OC irrigation water application with 2.45 g, and the lowest seedling fresh weight resulted from KC water with 1.60 g. In terms of variety × irrigation water interaction, the highest seedling fresh weight was seen in corn irrigated with OC water at 6.07 g, followed by control application in corn at 5.48 g. The lowest seedling fresh weight was observed in Italian ryegrass irrigated with KC water, at 0.21 g (Table 4).

3.6. Seedling Dry Weight (g)

The cultivar, irrigation water, and cultivar × irrigation water interactions were all statistically significant factors for seedling dry weight (Table 4 and Figure 4). The highest seedling dry weight was observed in corn at 0.62 g, followed by alfalfa at 0.47 g. The lowest seedling dry weight was observed in Italian ryegrass at 0.03 g. In terms of irrigation water, the highest seedling dry weight value was found to be 0.50 g from EC irrigation water, and the lowest seedling dry weight was reported from KC water at 0.26 g. The highest seedling dry weight in terms of cultivar × irrigation water interaction was observed in alfalfa irrigated with EC water at 1.03 g, followed by OC water at 0.75 g. The lowest seedling dry weight value, between 0.03–0.05 g, was observed in all applications in Italian ryegrass (Figure 4).

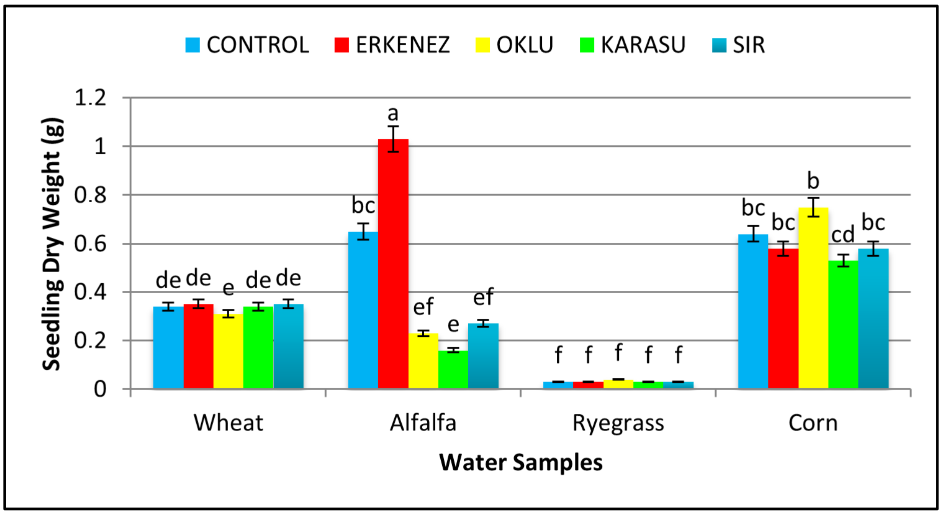

Figure 4. Effects of different irrigation waters on seedling dry weight (Error bars show ± standard errors. Different letters stand for statistically significant differences at $p < 0.05$ (Fisher LSD test)).

3.7. Vigor Index

In terms of the vigor index, the effects of variety, irrigation water, and the interaction between variety and irrigation water were found to be statistically significant (Table 4, Figure 5). The highest vigor index was recorded in wheat (2812), followed by alfalfa (1598), while corn exhibited the lowest vigor index (1322). Regarding irrigation water, the highest vigor index (1997) was observed with the SD irrigation water application, whereas the lowest vigor index (1177) was associated with KC water. For the variety × irrigation water interaction, the highest vigor index was obtained in wheat irrigated with OC water (3266), followed by wheat irrigated with SD water (3107). In contrast, the lowest vigor index (429) was recorded in Italian ryegrass irrigated with KC water (Figure 5).

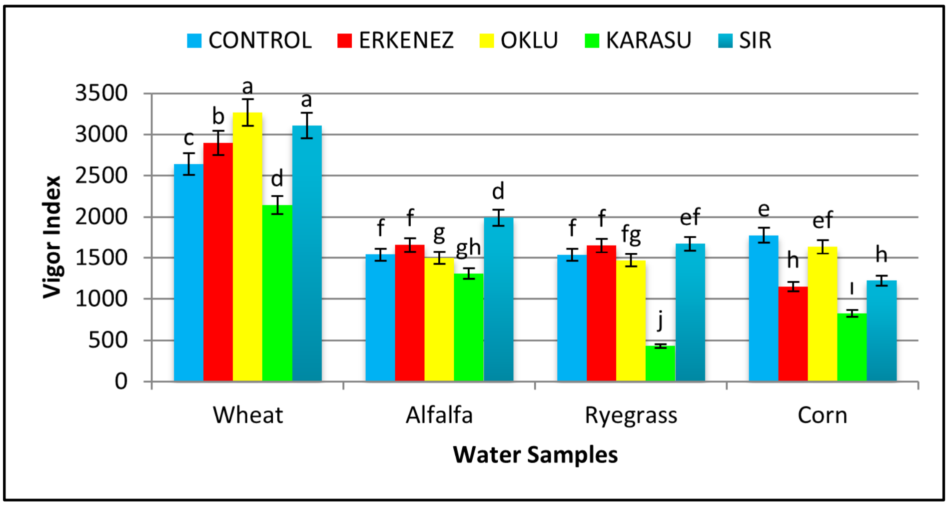

Figure 5. Effects of different irrigation waters on vigor index values of seeds (Error bars show ± standard errors. Different letters stand for statistically significant differences at $p < 0.05$ (Fisher LSD test)).

4. Discussion

Germination and the early plant growth stage are of critical importance in plant breeding [48]. Especially for field crops, germination success is essential for the abundant production of high-yield and high-quality plants [48,49]. Along with quality seeds, quality water supply, and irrigation frequency are also very important [50]. The decrease in water potential during germination periods can negatively affect seed germination and cause osmotic stress. Since the Mediterranean region is one of the more sensitive regions exposed to global climate change [51], irregularity in rainfall occurrence and amount causes water scarcity and encourages the use of alternative irrigation water sources. However, it should not be forgotten that the use of alternative irrigation waters containing heavy metals or having salinity problems is an important factor affecting germination and plant growth parameters [52]. In order for a plant to survive and continue its generation, the environment in which it grows must be free from heavy metal stress [53]. Similarly, some researchers have reported that heavy metal toxicity significantly reduces the germination rate and seedling growth of different plants [31,54]. In contrast, it has been stated that the germination and early seedling growth parameters of Leucaena are not affected by water quality [55], and winter wheat and spring maize plants can develop resistance after the early growth stage [56]. Although most plants have phytotoxic tolerance to some heavy metals, other heavy metals can cause serious negative effects on that plant. For instance, Talebi et al. [57] reported in a study that triticale germination percentage and rate were significantly affected by heavy metals, especially Cd. The data from our study reveals that wheat was the most resistant plant to heavy metals in irrigation water, exhibiting the highest germination rate. In particular, the heavy iron content of KC irrigation water reaches very dangerous levels, because this metal is present far above the permitted limits. For this reason, it has been observed that there is a significant decrease in the germination percentage of seeds due to the heavy metal concentration in irrigation waters. This may be due to the toxic effects of concentrated ions on the germination process [58].

The observed decrease in seed germination percentage due to the presence of heavy metals is consistent with the findings of other researchers. For example, Rahman Khan and Mahmud Khan [59] observed a decrease in seed germination in chickpeas treated with 50, 100, 200, and 400 ppm nickel and cobalt compared to the control. Similarly, Singh et al. [60] observed a decrease in germination percentage in wheat treated with copper at 5, 25, 50, and 100 ppm. Peralta-Videa [61] reported that alfalfa seed germination and seedling growth were adversely affected by heavy metals (Cd, Cr, Cu, and Ni). Azmat et al. [62] also reported that *Lens culinaris* seed germination was inhibited by Pb. Similarly, Talebi et al. [57] determined that Cu^{2+} and Cd concentrations applied at 1000 mg/L^{-1} were the most significant inhibitory factors for the germination and seedling growth of triticale seeds. Tsamo et al. [31] reported that there was a significant decrease in the germination rates of corn and bean seeds irrigated with increased Cu^{2+} element and that there was no germination in beans in 600 µmol/L Cu^{2+} solution. In this study, the Cu^{2+} concentration in all irrigation waters, Fe concentration in KC and SD waters, and Cd concentration in EC and SD waters were above the permissible amounts for the germination of seeds of different crops and early seedling development. High concentrations of Fe, Cu, and Cd can cause a wide range of phytotoxic symptoms such as reduced germination rate, chlorosis, root rot, and growth inhibition, as well as a wide range of morphological and physiological disorders [53,63–65]. Similarly, the presence of Co, Cu, and Zn in cucumber and wheat [32]; Zn in *Nigella sativa* and *Triticum aestivum* [33]; and Co in wheat, alfalfa, and tomato [34] resulted in reduced germination rates.

The lowest radicle length measured from the early seedling development parameters of the seeds was obtained from KC water. It is thought that the heavy metal content of KC water slows down the radicle development in parallel with the negative effect on the germination rate. Similarly, there is a direct relationship between the concentration of heavy metals used in irrigation and radicle length, because radicle length decreases as the heavy metal concentration increases [57,66]. The heightened sensitivity of root length to heavy metals can be attributed to the plant root being the initial point of contact with toxic substances in the growth medium. Some studies have indicated that Cd application has negative effects on *Triticum aestivum*, *Zea mays*, *Sorghum bicolor*, and *Cucumis sativus* plants, especially on the root part, the root being the most sensitive part of the plant [67,68]. Also, some researchers found that Al destroyed roots in wheat [69]; Hg, Cd, Co, Cu, Pb, and Zn in cucumber and wheat resulted in smaller root lengths, shorter root age, and lesser dry weight [32]; Co inhibited root growth in wheat, clover, and tomatillo [34]; Cd decreased the root growth and root tolerance index in maize [35]. Furthermore, some researchers have suggested that the inhibition of root elongation by heavy metals may result from interference with cell division, including the induction of chromosomal aberrations and abnormal mitosis [70], which could adversely affect seedling growth.

It is observed that Karasu Creek irrigation water, which contains high concentrations of Cu and Fe heavy metals, slows down plumule growth in parallel with its negative effect on germination rate and radicle length. Talebi et al. [57] the highest plumule length of triticale was determined in the control application and the shortest plumule length was determined in the highest (1000 ppm) heavy metal concentration. At higher concentrations, it was thought that the presence of inhibitory chemicals could completely stop seedling growth [71]. Maity et al. [72] found that the lowest values of growth parameters of *Cicer arietium* were a result of the use of industrial wastewater. The increase in heavy metal concentration in wastewater can cause inhibition of enzyme activity by reducing enzyme dehydrogenase activity, which is considered to be one of the biochemical changes that negatively affect seedling biomass. Cd absorbed by plants accumulates in different parts of the plant, causing growth inhibition and reducing root and shoot growth by inhibiting cell division and cell growth or both [73–75]. He et al. [76] reported that Cd inhibited plumule and radicle growth in rice.

In this study, it was observed that the highest and lowest seedling length values were compatible with radicle and plumule length values. According to seedling length, wheat was the most resistant to heavy metal-containing irrigation water. Seedling development was found to slow in parallel with the negative effects of heavy metals—particularly Cu and Fe—present in Karasu Creek irrigation water. Similarly, Maity et al. [72] stated that industrial wastewater negatively affected the seedling length of *Cicer arietium*. Athar and Ahmad [77] noticed that the toxic effects of certain heavy metals on the seedling length and grain yield of wheat (*Triticum aestivum* L.) caused significant decreases in both parameters, and that Cd was the most toxic metal, followed by Cu, Ni, Zn, Pb, and Cr.

KC irrigation water had negative effects on germination and seedling growth, impacting the mass formation of the plant. This could be due to the higher Fe concentration in KC irrigation water, well above the allowable limits. Similarly, Talebi et al. [57] reported that the presence of heavy metals significantly reduced the fresh and dry weight of triticale seedlings compared to the control. The ability of heavy metals to reduce the fresh and dry weight of triticale was as follows: Cd > Cu > Pb. Zeng et al. [78] reported that Pb caused a decrease in rice biomass. The decrease in biomass was also attributed to the inhibition of chlorophyll synthesis and photosynthesis by heavy metals [60,79]. These researchers observed a significant reducing effect on wheat (*Triticum aestivum* L.) fresh weight, and dry weight with increasing Cu^{2+} concentrations. Tsamo et al. [31] found that the fresh and dry weight of plants with high heavy metal concentrations was very low compared to control experiments. Similarly, Athar and Ahmad [77] reported that exposure of wheat plants to heavy metals resulted in a decrease in the dry weight content and grain yield of the plants and a significant decrease in the protein content in plant tissues and grains. This suggests that heavy metals negatively impact the growth and yield of wheat plants, corroborating previously reported phytotoxic effects of these metal ions [77]. In another study, it was determined that the aboveground biomass of maize and bean seedlings irrigated with different Cu^{2+} concentrations was shorter than the control [31]. The decrease in fresh and dry weight of plants may also be due to the concentration of heavy metals in water, protein degradation of amino acid metabolism at high concentrations [31], and a decrease in carotenoid and chlorophyll content [80].

There was a direct relationship between heavy metal concentration and a decrease in the vigor index; the vigor index decreased as the heavy metal concentration level increased. Similar results were also observed by Channappagoudar [81] and Talebi et al. [57]. Also, Shaikh et al. [82] studied the phytotoxic effects of different concentrations of Cr, Cd, Mn, and Zn on seed germination, root, shoot, seedling growth, seedling vigor index and tolerance index of wheat and found that heavy metals adversely affected the normal growth of plants by reducing seed germination, root and shoot length compared to control. It was determined that the highest vigor index value in terms of irrigation waters was obtained from SD water application, and the lowest vigor index from KC water. The negative effects of KC irrigation water on germination rate and seedling growth also decreased the vigor index values of the plant. This is due to the presence of iron heavy metal in KC irrigation water well above the allowable limits.

Heavy metals such as Fe, Cu, Zn, and Mn are essential for plant growth at appropriate concentrations, but some are harmful to plants when exceeded above acceptable levels [31,83]. These include Cd, Hg, Pb, and As [84]. For example, high concentrations of Pb and Cu also cause oxidative stress in plants [85], which leads to the destruction of macromolecules and the disruption of metabolic pathways [86]. Vassilev et al. [87] showed in their study how copper toxicity affects the growth of barley plants. This toxicity caused leaf chlorosis by degrading photosynthetic elements. In our study, the Cu element was found to be a phytotoxic metal for plants in all water samples, Fe element in KC and SD waters, and Cd element in EC and SD waters. Athar and Ahmad [77] found that Cd was the most toxic metal for free-living nitrogen-fixing bacteria and wheat plants, causing significant decreases in the dry weight of shoot, root, and grain yield after Cu, Ni, and Zn, respectively. Kalyanaraman and Sivagurunathan [88] reported that Cd and Cu had higher phytotoxicity than other elements. Similarly, Tsamo et al. [31] reported that heavy metals Zn and Cu significantly affected other plant growth parameters such as germination, shoot length, leaf area index, and shoot circumference of bean plants and Pb of maize. However, the presence of more than one heavy metal concentration in the environment may also cause antagonistic effects [77]. For example, it has been reported that Cd antagonized the inhibitory effect of Zn on the total amount of mineralized carbon [89]. It has been reported that the decrease in seed germination and plant growth parameters is a reflection of the increase in industrial pollution [90].

5. Limitations of the Study

The Aksu River is home to numerous textile factories, and a more comprehensive study would require analyzing the wastewater from each factory to identify the primary pollutants and implement necessary precautions. This research needs to be conducted in larger areas in different regions and larger water resources. Certain heavy metals (Cu, Fe, Pb, Cr, As, Ni, Cd) were analyzed in this study. However, the effects of other potentially toxic elements (e.g., Zn, Mn) should also be examined. The study was conducted in a controlled laboratory environment. Under field conditions, the mixing of irrigation water with the soil and its long-term effects could not be evaluated. Only four different field crops (wheat, alfalfa, meadow grass, and corn) were used. Studies with more plant species may be useful to determine the tolerance of different species to heavy metals. It would be useful to examine the accumulation rates of heavy metals not only in irrigation water but also in soil and plants. In addition, the long-term effects of heavy metals in irrigation water on plant growth and development, yield, and soil vitality should be investigated. Biological or chemical treatment methods should be tested and their effects should be examined to eliminate the negative effects of heavy metals. Species resistant to heavy metal toxic effects should be studied.

6. Conclusions

The effect of environmental stress factors on plants is generally determined by the responses of the organelles whose morphological and functional integrity are affected. In this study, the effects of polluted irrigation waters on germination and early seedling growth performances of some field crop species were investigated. All irrigation waters containing heavy metals significantly reduced the germination and seedling growth of wheat, alfalfa, ryegrass, and maize seeds. In particular, Karasu Creek irrigation water had the most negative impact on germination and early development of all plant seeds. In addition, corn and Italian ryegrass seeds exhibited poorer germination compared to wheat and alfalfa seeds under heavy metal pollution. According to the results obtained from this study, reduced germination and delayed growth will be observed in plants grown in soils in irrigation processes with water contaminated with heavy metals. The most important reason for this is that high concentrations of heavy metals alter the physiological and biochemical activities of seeds. This study highlights the risk to the yield and availability of wheat, alfalfa, ryegrass, and maize in the studied regions if agricultural areas are not protected from various soil pollutants, particularly those resulting from industrial activities near farmlands. To mitigate these issues, wastewater treatment systems in factories near streams must remain continuously operational, and strict legal measures should be enforced. Additionally, irrigation water from the Aksu River and Sır Dam should be filtered and treated to remove heavy metals before use. The findings of this study will aid farmers and city officials in educating the public on the impact of environmental pollution on food security, livelihoods, and overall health.

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RESEARCH ARTICLE

Fermentation and silage quality of sorghum (*Sorghum bicolor* L. Moench) grown with organic fertilise

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ABSTRACT

Sustainable agriculture includes environmentally conscious production practices such as the use of organic fertilisers, green fertilisers, effective water usage techniques, crop rotation systems, and biological control of pests, diseases, and weeds. Organic fertilisers increase crop yields and soil fertility without endangering environmental health. On the other side, ensiling depends on epiphytic microorganism flora, such as lactic acid bacteria, enterobacteria, mold, and yeast. The source of LAB is the epiphytic flora on plant material, and its main source is soil. Therefore, introducing fertilisers to the soil might modify the microflora of silage, thereby altering both the soil and sillage qualiity. A study was done for a period of two years, from 2020 to 2021, to evaluate organic fertilisers such as vermicompost, bovine dung, sheep manure, gyttja, and chicken manure with traditional systems. The results obtained for plant height, number of leaves, and fresh forage production demonstrated that chicken manure was similar to typical nitrogen application in terms of yield. Additionally, the effect of fertiliser on forage sorghum yield was different depending on plant cultivar. The findings indicated the beneficial application of chicken manure in sorghum cultivation, as it improved the production of sorghum plants relative to conventional nitrogen fertilisers.

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Agricultural sustainability; forage quality; silage fermentation; organic fertiliser; forage yield

Introduction

The increased use of inorganic fertilisers has both positive and negative effects. While it contributes to food security, it also causes soil acidification and salinisation, water contamination, loss of soil fertility, nutrient imbalances, greenhouse gas emissions, and loss of beneficial soil organisms (Chen et al. 2001). Greenhouse gas emissions have also become an international concern as a result of the increasing use of chemical fertilisers (Islam et al. 2022). Continually high levels of chemical fertilisers are not sustainable, and ecological principles and regulations should be followed in agricultural activities. Therefore, applications such as ‘Ecological Agriculture’ and ‘Sustainable Agriculture’ have been developed to mitigate the adverse effects associated with conventional farming methods (Soyergin 2003).

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The production of food and other agricultural products at an environmental cost that does not compromise future generations' access to food and general well-being is known as sustainable agriculture. It also incorporates environmentally friendly production models such as organic and green fertilisers, crop rotation systems, efficient water use techniques, and biological control of pests, diseases, and weeds (Robertson 2015). Organic waste contains mineral nutrients, water, and organic matter, and it's used to increase plant production and prevent them from harmful pests without polluting the environment. Hui et al. (2017), defined that the application of organic fertilisers instead of chemical fertilisers was one of the most eco-friendly. There are many different sources of organic fertiliser. Their use is becoming increasingly widespread around the world. Saltalı (2015) reported that due to its high humic content, gyttja manure can be used in agricultural fields. Addition, Oagile and Namasiku (2010) impressed that chicken manure is preferred over other animal wastes due to its high concentration of macronutrients. Xu et al. (2016) expressed that vermicompost could improve plant growth and soil salinity. Khaliq et al. (2006) reported that the influence of organic fertilisers on plant yield is slow and changeable.

Silage sorghum (*Sorghum bicolor* L.) is a forage plant widely used for silage production due to its high biomass yield, allowing for multiple harvests during the summer months; suitability for mechanised agriculture; suitability for second cropping and rotation systems; suitability for livestock feed; and good nutritional composition, such as carbohydrates, proteins, fibre, minerals, and vitamins (Sağlamtimur et al. 1998; Cothren et al. 2000). Addition, valued for its high energy content and digestibility, makes it a valuable feed source for ruminant animals such as cattle, sheep, and goats. Sorghum plants using the C4 photosynthetic pathway have an efficiency advantage, especially in hot and dry environments (Mullet et al. 2014; Tiryaki 2005; von Caemmerer and Furbank 2016). According to Newman et al. (2013), requiring less N fertilisation, the sorghum needs an average of 30% less water than maize to deliver good forage yield. Therefore, in most areas it is considered an alternative to maize plants. Sorghum plants produce more biomass than other cereal plants, which provides and naturally exploits more nutrient elements in the soil. Therefore, excessive amounts of chemical fertilisers are applied to ensure a high yield rate in the query plant. However, adverse effects of chemical fertilisers on the soil and the environment, the use of organic fertiliser is increasingly widespread due to its eliminating effect on the beneficial microorganisms in the ground. On the other hand, ensiling is the important forage source obtained as a result of the natural lactic acid fermentation of rich, fresh forage under anaerobic conditions (Dunière et al. 2013). Ensiling depends on epiphytic microorganism flora, such as lactic acid bacteria (LAB), enterobacteria, mold and yeast. The desired microorganisms in the silage are primarily LABs. The source of LAB is the epiphytic flora on plant material, and its main source is soil (Kızılşimşek et al. 2016). Therefore, applications to the soil can also change the microflora of silage, as it can affect the yield of soil and plants.

The aim of this study was to evaluate the performance of the various fertilisers, such as vermicompost, cattle manure, sheep manure, gyytja, chicken manure, and traditional nitrogen application, on silage sorghum.

Materials and methods

Experimental locations, climate and soil description

A field experiment was conducted during the period (May-September 2020 and 2021) in the Faculty of Agriculture Engineer, University of Kahramanmaras Sutcu Imam in Kahramanmaras, Türkiye. The influence of different fertiliser treatments (vermicompost, cattle manure, sheep manure, gyytja, chicken manure, and traditional nitrogen application) on the growth and forage yield of Nes and Jumbo cultivars. The soil was determined to have a clay loam (70.4) texture, with a pH of 7.54, indicating a slightly alkaline condition. It was found to be non-saline, low in organic matter content, and had good levels of potassium and phosphorus.

Some climatic data in the region are given in Table 1. It has been concluded that the total amount of precipitation is insufficient for sorghum cultivation, and irrigation is necessary. Available relative humidity in 2020 was higher than in 2021. The average temperature was determined to be 27.11°C in 2020 and 27.08°C in 2021.

Experimental design and treatment

The trial plan was arranged in split plots in a completely randomised block design with 3 replications. Organic fertiliser applications and sorghum cultivars were placed as the main plots and sub-plots, respectively. Each sub-plot consisted of 4 planting rows with a spacing of 70 cm between rows and a length of 5 m. A distance of 2 m was left between the blocks. The experimental area covered an area of 19 m x 37.1 m = 704.9 m^2. Organic fertilisers applied for the sorghum mixture were applied as 1.6 ton da^{-1} gyttja, 0.8 ton da^{-1} vermicompost, 1.2 ton da^{-1} sheep manure, 1.4 ton da^{-1} cattle manure, and 1.0 ton da^{-1} chicken manure, which are corresponding to traditional nitrogen application doses of 25 kg da^{-1}.

Forage yield measurement

Plant height: Ten plants were randomly selected from the 2nd and 3rd ridges of each individual plot, and the plant was measured and recorded in (cm). The number of leaves: Ten plants were randomly selected from the 2nd and 3rd ridges of each individual plot, and the number of leaves was determined. Fresh forage yield: When the sorghum plant reached the pulp stage, an area of 5.6 m^2 was cut with a sickle and immediately weighed into da. Hay yield: The green forage of the 5.6 m^2 was left to dry in an oven until a constant weight was reached, then final dry matter yield was calculated in da. When the sorghum reaches the pulping period, all parcels are harvested.

Table 1. Climatic data of Kahramanmaraş province for silage sorghum vegetation period.

	Precipitation (mm)			Temperature (°C)			Relative humidity (%)		
	2020	2021	Long years	2020	2021	Long years	2020	2021	Long years
May	23.00	12.00	38.8	21.16	23.15	20.1	54.44	47.76	54.7
June	0.00	0.00	8.6	25.24	26.02	24.9	50.21	48.12	49.2
July	0.00	0.00	2.7	30.75	30.69	28.3	46.43	43.12	44.2
August	0.00	2.60	2.2	29.65	30.25	28.4	40.95	44.82	48.76
September	0.00	2.40	11	28.75	25.28	25	42.86	45.73	45.41
Total/Mean	23.00	17.00	63.3	27.11	27.08	25.34	46.98	45.91	48.45

Silage fermentation and quality analysis

Plant samples of sorghum were cut separately in a silage chopping machine to approximately 2–4 cm. Afterward, approximately 500 g of the treatment sorghum samples were placed in special plastic silage packages, and the mouth was compressed automatically. Three silage packages were prepared for each treatment. In order to determine the initial dry matter content (DM T0), approximately 100 g of the chopped sample was dried in an air-forced oven at 70 °C for 48 hours. Silages were opened after 60 days and analysed for pH, dry matter (DM), crude protein (CP), crude ash (CA), ether extract (EE), neutral detergent fibre (NDF), acid detergent fibre (ADF), and acid detergent lignin (ADL). Approximately 100 g samples were taken from each opened silage package and kept in an oven at 70 °C for 48 hours, and DM (T60) was determined. The dried forage samples obtained were ground in a grinding machine with a 1 mm sieve and made ready for analysis. The nitrogen content of the silages was determined using the Kjeldahl method, and then CP content was calculated by multiplying it by 6.25 times. Ash by igniting the samples in a muffle furnace at 525 °C for 8 hours (AOAC 1990). Neutral detergent fibre (NDF) and acid detergent fibre (ADF) of the silages were determined by the method of Van Soest et al. (1991).

pH measurements 20 g samples were taken from the fresh material from T0 and T60 forages, 180 ml of Ringer solution were added, and mixed with a blender at high speed for one minute. Silage extracts were filtered through Whatman 54 filter paper and microorganism counts were made by making ten-fold dilution series. Lactic acid bacteria numbers were determined by pour plating in MRS agar with double overlaying for anaerobic conditions, and plates were incubated at 36 °C for 48–72 h. Enterobacteria counts were enumerated by pour plating in VRBD agar with a single overlay, and plates were incubated at 36 °C for 18 h. Yeast and mold counts were enumerated by pour planting MEA acidified with lactic acid to pH 4 and with a single overlay, and plates were incubated at 32 °C for 48 h.

Statistical and correlation analysis

The statistical calculations for the data obtained in this study were performed using a split plot in a randomised complete design with the statistical programme JMP.

Results

Forage yield measurement

Sorghum plant length was significantly affected by year ($p < 0.01$), varieties ($p < 0.01$), fertiliser ($p < 0.01$), Y × C ($p < 0.01$), and F × C ($p < 0.01$) interactions, according to the

Table 2. Statistical analysis results of investigated characteristics in the present study.

	Plant length	The number of leaves	Fresh forage yield	Hay yield
Years (Y) LSD (0.05)	5.21**	0.51**	ns	ns
Cultivars(C) LSD (0.05)	5.21**	0.51**	138.49**	ns
Y × C LSD (0.05)	7.37**	ns	195.86*	ns
Fertilisers(F) LSD (0.05)	9.02**	0.87**	239.92**	76.03**
Y × F LSD (0.05)	ns	ns	339.25**	107.52**
F × C LSD (0.05)	12.79**	ns	339.25**	ns
Y × C × F LSD (0.05)	ns	ns	479.77**	152.06**

**$P < 0.01$;*$P < 0.05$; ns: non-significant.

results of the statistical test (Table 2). Overall, the chicken fertilisation significantly influenced ($p < 0.01$) the plant length and increased this parameter by 16.60% compared to the traditional nitrogen application control. Chicken manure increased plant height from 232.05 cm (traditional application) to 242.57 cm, while sheep manure and vermicompost had no effect on plant height. Sorghum plant length, the number of leaves, and fresh forage yield in Nes were lower than Jumbo (Table 3). According to the F × C interaction, the plant height is reduced in varieties compared to the traditional nitrogen application when applying cattle manure and gyttja organic material as fertilisers. In parcels where chicken manure was applied compared to the traditional cultivation system, an increase of 8.7% in plant height was observed in the Jumbo cultivar, while the Nes cultivar showed a 0.8% increase in plant height (Figure 1A).

While the effect of Y × C, Y × F, F × C, and Y × F × C interactions on the number of leaves was not significant, the effects of year ($p < 0.01$), cultivars ($p < 0.01$), and fertilisers ($p < 0.01$) were significant (Table 3). The number of leaves of the sorghum forages varied between 10.67 and 12.84 according to fertiliser treatments (Table 3). The highest number of leaves was determined in the traditional nitrogen application (12.84) and chicken manure (12.51) treatment and the lowest in the cattle manure (10.67) treatment. The highest number of leaves was observed in the Jumbo (13.45) cultivar and the lowest in the Nes (10.09).

While the effect of year on fresh forage yield was not significant, the effects of cultivars ($p < 0.01$), fertiliser ($p < 0.01$), Y × C interaction ($p < 0.05$), Y × F, F × C, and Y × F × C interaction ($p < 0.01$) were significant (Table 2). Among the fertiliser treatments, the fresh forage yields varied between 2129.3 kg da^{-1} and 3582.6 kg da^{-1}. The highest fresh forage yield was obtained from chicken manure and traditional nitrogen application. In addition, sheep manure, gyttja organic material, and vermicompost gave statistically similar results. The lowest fresh forage yield was determined in cattle manure application parcels (Table 3). According to the F × C interaction, the highest fresh forage yield was recorded in traditional nitrogen application in the Jumbo cultivar, while the lowest value was in cattle manure in the Nes cultivar (Figure 1B).

While the effect of year, cultivar, Y × C interaction, and F × C interaction on hay yield was not significant, the effects of fertiliser ($p<0.01$), Y × F interaction ($p<0.05$), and Y ×

Table 3. Plant length, stem thickness, the number of leaves, the leaf ratio in fresh forage, the stalk ratio in fresh forage value of years, cultivar and fertilisers.

	Plant length (cm)	The number of leaves	Fresh forage yield	Hay yield
Years				
2020	251.01a	12.75a	2914.09	758.69
2021	198.59b	10.79b	2756.85	709.31
Cultivars				
Nes	195.46b	10.09b	2756.85b	750.61
Jumbo	254.14a	13.45a	2914.09a	717.39
Fertilisers				
Traditional Nitrogen	232.05b	12.84a	3442.2a	898.03a
Cattle Manure	202.31d	10.67d	2129.3c	545.87c
Sheep Manure	229.66b	11.98ab	2723.0b	705.89b
Gyttja	215.64c	11.08cd	2581.6b	666.81b
Chicken Manure	242.57a	12.51a	3582.6a	940.35a
Vermicompost	226.60b	11.54bc	2554.2b	647.07b

Note: [a–d]Mean values with different superscripts have significant differences.

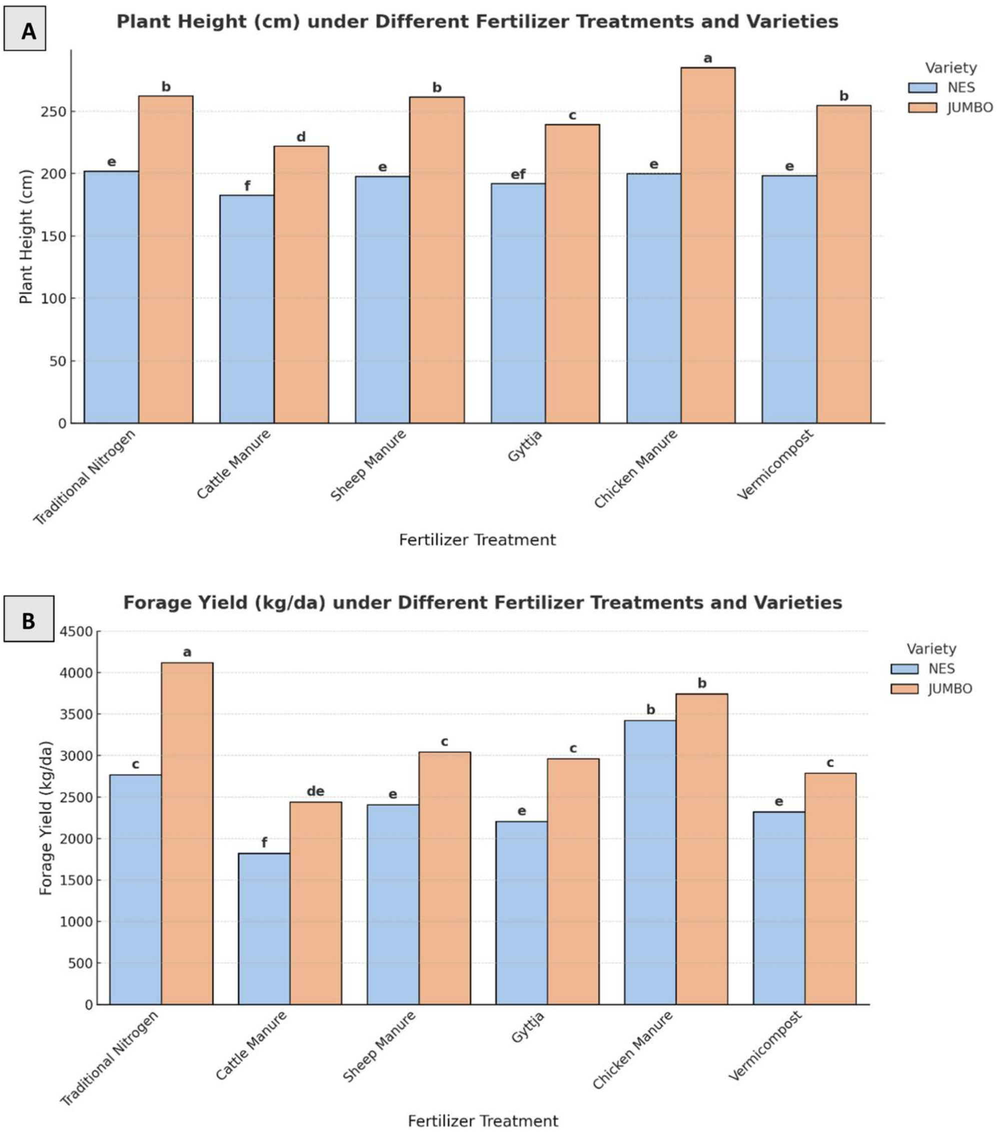

Figure 1. A, Plant height changes of Cultivar × Fertiliser interactions; **B,** Fresh forage yield changes of Cultivar × Fertiliser interactions.

F × C interaction (p<0.01) were significant (Table 2). In the fertiliser treatment, the highest hay yield was obtained from chicken manure with 940.35 kg da^{-1} and from the traditional nitrogen application with 898.03 kg da^{-1}, which were statistically considered in the same group. Additionally, sheep manure, vermicompost manure, and gyttja organic fertiliser were statistically the same group. The lowest hay yield of 545.87 kg da^{-1} was obtained from cattle manure (Table 3). Fertiliser treatment among them showed that chicken manure showed related results to the traditional nitrogen application, while other organic fertilisers were statistically grouped among themselves. It was also observed that cattle manure resulted in the lowest hay yield.

Silage fermentation and quality analysis

According to the results of the statistical test (Table 4), there were significant effects of cultivars and Y × C × F interactions on DM (T_0) ($p < 0.01$). Among the cultivars, the highest DM (T_0) value was obtained from Nes (%30.20). The DM (T_{60}) value from 2021 is higher than the 2020 value. In addition, significant differences were found among cultivars with respect to DM content in the resulting silage (T_{60}).

The effects of year, cultivars, and the Y × C interaction on the pH of initial silages were significant (Table 4). Results showed that organic fertiliser applications do not affect the initial pH of silage, and the silages presented similar pH values. While the effect of Y × C, Y × F, F × C, and Y × C × F on pH (T_{60}) is insignificant, the effects of year (p<0.01), cultivars (p<0.01), and fertilisers (p<0.01) were significant (Table 4). The highest pH was obtained from the Jumbo cultivar with 4.33, while the lowest was found from the Nes cultivar with 4.07.

The highest lactic acid bacteria count was obtained from the Jumbo cultivar with 4.71 (log_{10} cfu/g resulting silage), while the lowest was found from the Nes cultivar with 3.52 (log_{10} cfu/g resulting silage). The count of lactic acid bacteria was similar among organic fertiliser treatments in resulting silage. In addition, a higher number of LAB in 2021 may be associated with a higher DM content. In F × C interactions, the highest lactic acid bacteria count was recorded in traditional nitrogen, gyttja, and vermicompost in the Jumbo cultivar, while the lowest value was in vermicompost manure in the Nes cultivar (Figure 2A).

While the effect of year, cultivar, Y × C interaction, fertilisers, F × C, and Y × F × C interaction on enterobacteria count was significant, the effects of Y × F interaction were not significant (Table 4). In the fertiliser treatment, the highest enterobacteria count was obtained from chicken manure and traditional nitrogen application, which were statistically considered in the same group. The lowest enterobacteria count was obtained from cattle manure (Table 5). On the other hand, other organic fertilisers have been found to reduce the count of enterobacteria found in the natural flora of plants. Among the cultivars, the highest enterobacteria count (T_0) was obtained from Jumbo (6.79 log_{10} cfu/g fresh material). In Y × C interaction, the highest enterobacteria count was obtained in Jumbo in 2020, and the lowest enterobacteria count was obtained in Nes in 2021 (Figure 2B). Enterobacteria were not detected in the end of fermentation.

It was determined to be 4.17 (log_{10} cfu/g fresh material) in the Nes variety and 4.27 (log_{10} cfu/g fresh material) in the Jumbo variety. In the fertiliser treatment, the highest mold count was obtained from chicken manure, and the lowest count of mold was determined in parcels used for cattle manure and sheep manure, which were statistically considered in the same group. In the F × C interaction, the highest mold count was recorded in chicken manure in the Jumbo cultivar, while the lowest value was in cattle manure in the Nes cultivar (Figure 3A).

Mold were not detected in end of fermentation. While the effect of year and cultivar on yeast count were significant, the effects of fertilzers, Y × C, Y × F, F × C and Y × C × F interaction were not significant (Table 4). According to the varieties, the number of yeast in silages varied between 2.38 and 3.16 (log10 cfu/g resulting silage), and the highest number was obtained from the Jumbo variety. In Figure 3B, the highest yeast count was recorded in traditional nitrogen, cattle manure and vermicompost in Jumbo cultivar, while the lowest value was in chicken manure in Nes cultivar.

The chemical composition of the resulting silage are given in Table 6, Table 7. The percentage of CP increased ($p < 0.05$) with organic fertilisers, ranging from 4.15% to

Table 4. Statistical analysis results of investigated characteristics in the present study.

	DM (T_0)	DM (T_{60})	pH (T_0)	pH (T_{60})	Lactic acid bacteria (T_0)	Lactic acid bacteria (T_{60})	Enterobacteria (T_0)	Mold (T_0)	Yeast (T_0)	Yeast (T_{60})
Years (Y) LSD (0.05)	ns	1.01*	0.04**	0.08**	ns	0.24*	0.22*	0.24*	0.20**	ns
Cultivars (C) LSD (0.05)	**	1.01**	0.02**	0.08**	ns	0.24**	0.22**	ns	0.20*	0.25*
Y × C LSD (0.05)	ns	ns	0.06**	ns	ns	ns	0.30*	ns	ns	ns
Fertilisers (F) LSD (0.05)	ns	ns	ns	0.14**	ns	ns	0.38**	0.42*	ns	ns
Y × F LSD (0.05)	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns
F × C LSD (0.05)	ns	ns	ns	ns	ns	0.61**	0.53**	0.61*	ns	0.61**
Y × C × F LSD(0.05)	2.90**	3.49**	ns	ns	ns	ns	0.75**	ns	ns	ns

**$P < 0.01$; *$P < 0.05$; ns: non-significant.

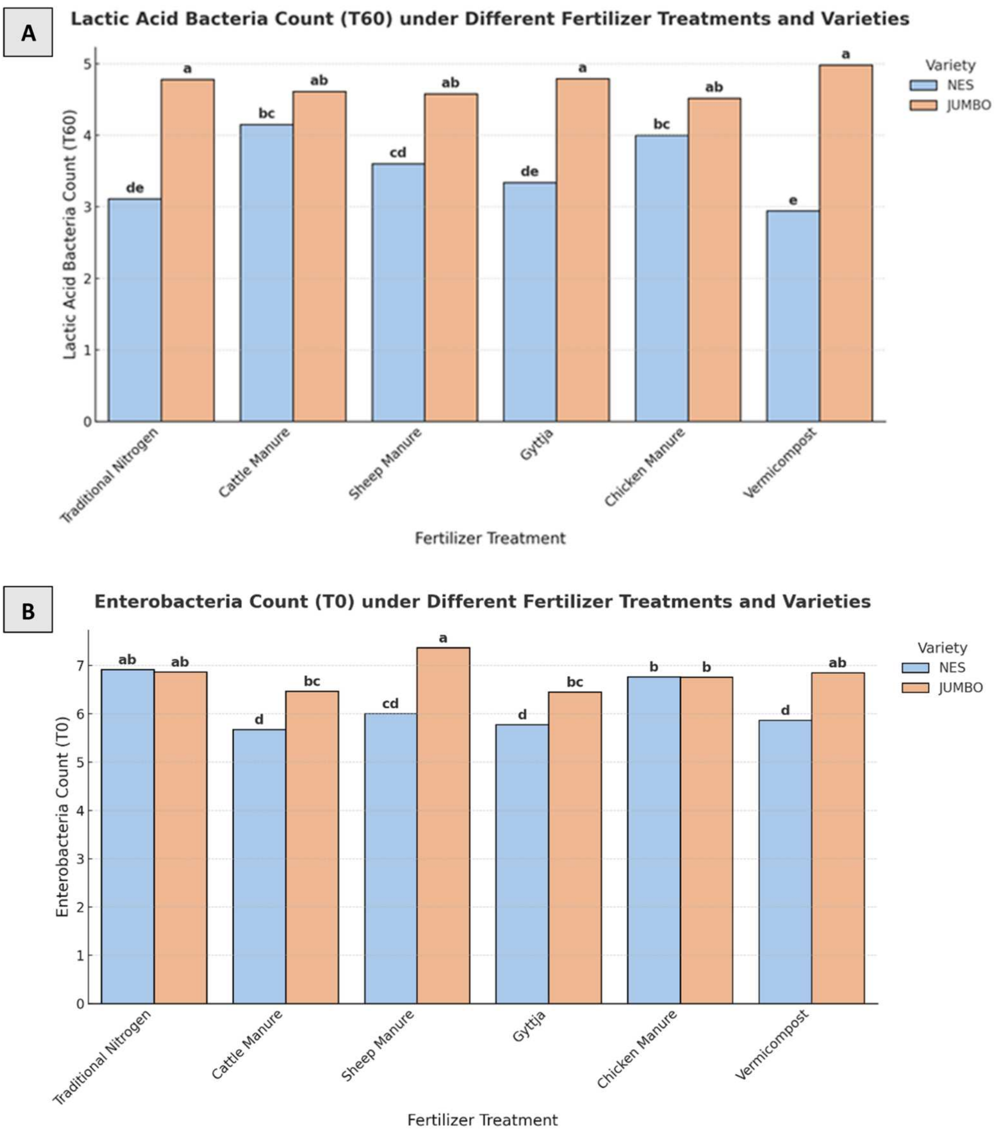

Figure 2. A, Lactic acid bacteria (T_{60}) count of Cultivar × Fertilisers interactions, **B,** Enterobacteria count of (T_{60}) Cultivar ×Fertilisers interactions.

6.55% (Table 7). This linearly increasing CP content in the silage is explained by the fact that chicken manure. In addition, was no difference between the CP values of the sorghum varieties, but there is a statistically significant difference between OM and ash content (Table 7).

The lowest NDF and ADF content has been detected in the Nes cultivar. While the effect of year, cultivar and Y × C × F interaction on CT content were significant, the effects of fertilisers, Y × C, Y × F and F × C were not significant (Table 6). According to the varieties, condense tannin content varied between 0.64% and 1.31%, and the highest CT content was obtained from the Nes variety.

Table 5. DM content (T_0,T_{60}), pH value (T_0, T_{60}), LAB count (T_0, T_{60}), enterobacteria count (T_0, T_{60}), Mold count (T_0) and yeast count (T_0, T_{60}) value of years, cultivar and fertilisers.

	DM (T_0)	DM (T_{60})	pH (T_0)	pH (T_{60})	LAB (T_0)	LAB (T_{60})	Enterobacteria (T_0)	Mold (T_0)	Yeast (T_0)	Yeast (T_{60})
Years										
2020	26.63	23.58b	5.56a	4.33a	4.08	3.98b	6.73a	4.10b	4.79b	2.72
2021	26.16	25.63a	5.63b	4.07b	3.98	4.25a	6.24b	4.34a	5.11a	2.82
Cultivars										
Nes	30.20a	27.81a	5.56a	4.10b	4.00	3.52b	6.17b	4.17	4.90b	2.38b
Jumbo	22.50b	21.40b	5.53b	4.29a	4.06	4.71a	6.79a	4.27	5.00a	3.16a
Fertilisers										
TraditionalNitrogen	26.95	26.15	5.57	4.17b	4.09	3.95	6.90a	4.25ab	5.16	2.71
Cattle Manure	26.16	23.71	5.56	4.21b	3.95	4.38	6.08c	4.03b	4.81	3.06
Sheep Manure	26.46	24.10	5.55	4.37a	4.14	4.09	6.69ab	3.93b	5.14	2.96
Gyttja	26.32	24.43	5.52	4.14b	4.00	4.06	6.11c	4.21ab	4.87	2.78
ChickenManure	26.60	25.22	5.54	4.18b	4.03	4.26	6.74a	4.61a	4.78	2.42
Vermicompost	25.90	24.02	5.53	4.13b	3.99	3.96	6.36bc	4.32ab	4.94	2.71

**$P < 0.01$. [a,b,c]Means within a row with different letters differ by LSD's test. DM T_0: Dry matter in fresh material, DM (T_{60}): dry matter in maturing silage, LAB(T_0): lactic acid bacteria count in fresh material, LAB(T_{60}): lactic acid bacteria count in maturing silage.

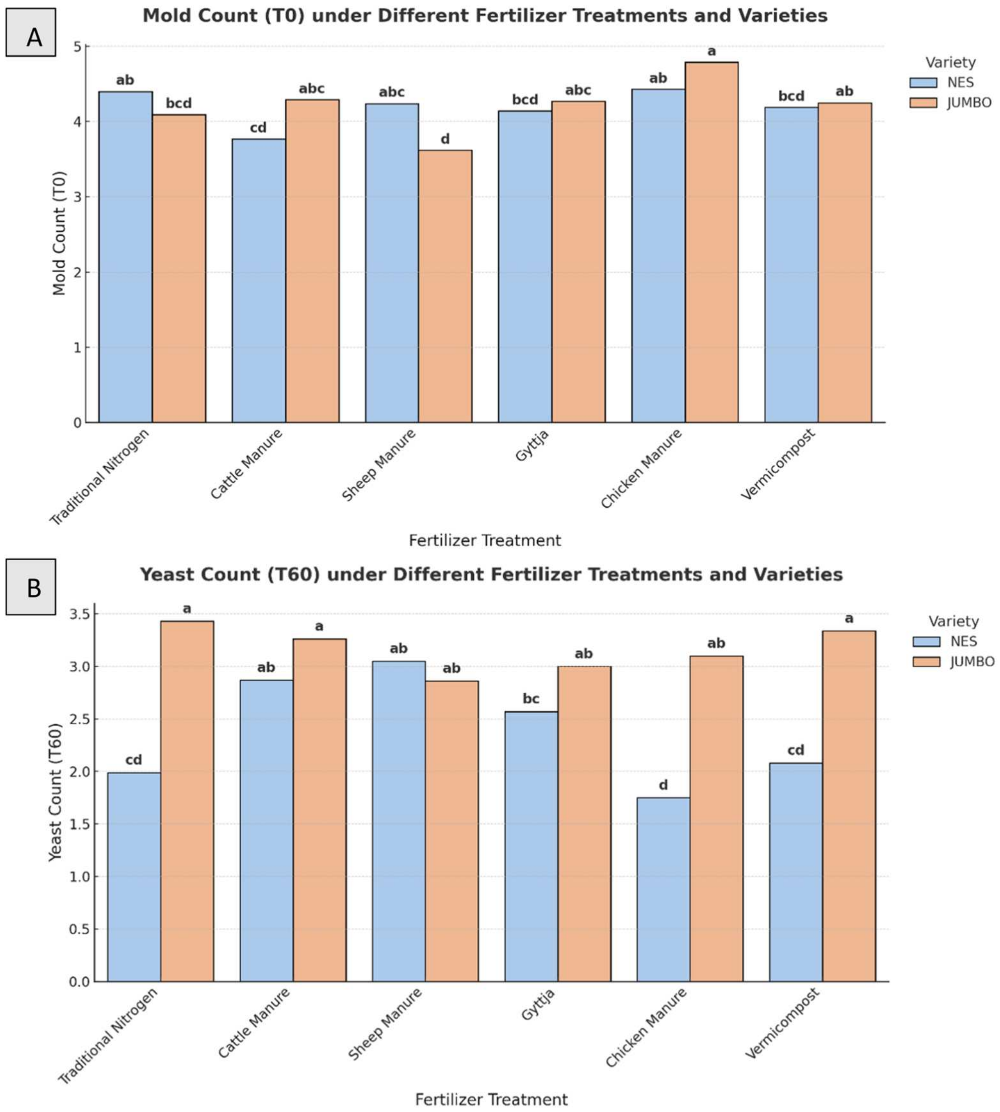

Figure 3. A**,** Mold count (T_0) of Cultivar × Fertilisers interactions, **B,** Yeast count of (T_{60}) Cultivar ×Fertilisers interactions.

Table 6. Statistical analysis results of investigated forage nutrition composition in the present study.

	CP	OM	Ash	NDF	ADF	CT
Years (Y) LSD (0.05)	ns	0.41**	0.40**	8.97 **	ns	8.97**
Cultivars (C) LSD (0.05)	ns	0.41**	0.40**	63.05**	2.61**	63.05**
Y × C LSD (0.05)	0.77**	ns	ns	1.33**	ns	ns
Fertilisers (F) LSD (0.05)	0.63**	ns	ns	ns	ns	ns
Y × F LSD (0.05)	ns	ns	ns	ns	ns	ns
F × C LSD (0.05)	1.09**	ns	ns	ns	ns	ns
Y × C × F LSD (0.05)	ns	ns	ns	ns	ns	3.07*

**$P < 0.01$. [a,b,c] Means within a row with different letters differ by LSD's test. ns: non-significant CP: crude protein ratio, OM:organic matter ratio, Ash: crude ash ratio,NDF:neutral detergent fibre, ADF: acid detergent fibre, CT: condense tannin.

Table 7. CP, OM, Ash, NDF, ADF, CT (%) content of silage sorgum (T_{60}).

	CP	OM	Ash	NDF	ADF	CT
Years						
2020	5.08	90.25b	9.75a	60.43b	35.22	1.09a
2021	4.89	91.29b	8.71b	65.72a	37.24	0.85b
Cultivars						
Nes	4.82	92.13a	7.87b	59.20b	32.67b	1.31a
Jumbo	5.19	89.41b	10.59a	66.94a	39.78a	0.64b
Fertilisers						
Traditional Nitrogen	5.06b	91.02	8.99	63.72	35.69	1.08
Cattle Manure	4.53bc	90.84	9.17	63.96	36.26	1.14
Sheep Manure	4.55bc	90.36	9.64	62.40	34.97	0.83
Gyttja	5.06bc	90.72	9.28	62.76	36.36	1.15
Chicken Manure	6.55a	91.02	8.98	62.53	37.19	0.86
Vermicompost	4.15c	90.66	9.34	62.97	36.92	0.79

Notes: CP: crude protein ratio, OM: organic matter ratio, Ash: crude ash ratio, NDF: neutral detergent fibre, ADF: acid detergent fibre, CT: condense tannin.

Correlation relationship between character

The plant height variable has a direct, positive effect with the same correlation sign with 5 different variables, such as the number of leaves, fresh forage yield, pH (T_{60}), crude ash content, and enterobacteria count (T_0). There was a positive and strong correlation between the number of leaves and fresh forage yield, hay yield, pH (T_{60}), crude ash count, enterobacteria count, and lactic acid bacteria count (T_{60}). In addition, there was a positive correlation between the number of leaves and NDF, ADF, crude protein ratio, yeast count (T60), and LAB count (T_0). At the same time, there is a negative and strong relationship between the number of leaves and dry matter rates.

Explanatory variables are the main determinants of changes in the main variable. As a result, it is possible to estimate the efficiency of indirect selection. As a result, it is possible to estimate the efficiency of indirect selection. In this case, the number of leaves and the number of LAB with DM stand out as the most associated variables. These variables are of great importance when it is desired to get answers related to LAB. In other words, while there was a positive relationship between DM (T_0) and lactic acid bacteria count (T_0), a negative relationship was observed between enterobacteria count (T_0), yeast count, and mold count. Therefore, increasing dry matter content will increase the number of desired microorganisms in silage and decrease the number of undesired microorganisms. There is a negative and strong relationship between the pH variable and DM; therefore, a decrease in pH value will be observed when the dry matter is high. It was determined that there was a negative relationship between the pH of fresh material and the number of microorganisms (Figure 4).

Discussion

Chicken manure increased plant height from 232.05 cm (traditional application) to 242.57 cm, while sheep manure and vermicompost had no effect on plant height. Similarly, Khaliq et al. (2006) reported that the application of a mixture of chicken manure and urea showed the best performance of all treatments applied. Furthermore, Agbede et al. (2008) reported that the application of chicken manure significantly increased plant height. Through the utilisation of gyttja and cattle manure, a decrease in plant

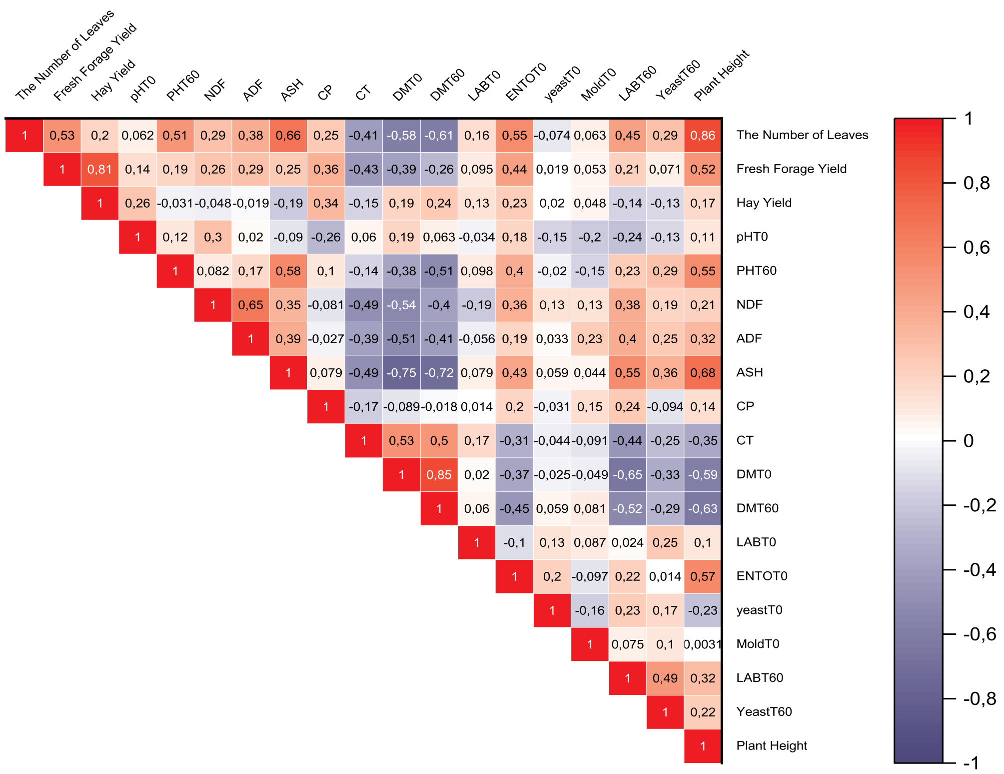

Figure 4. Correlation relationship between character. DM(T_0): Dry matter of fresh material, DM(T_{60}): dry matter of mature silages, Ash: ash ratio, CP: crude protein ratio, LAB: lactic acid bacteria count, Ento: enterobacteria count, NDF: neutral detergent fibre, ADF: acid detergent fibre, CT: condense tannin.

height has been observed. Particularly, the lowest plant height was attained through the application of cattle manure. Plant height is a significant trait that exerts an influential impact on yield in forage plants cultivated with the aim of achieving optimal productivity and facilitating silage production (Geren and Kavut 2009). It has been reported by some researchers that it may vary according to varieties (Güney et al. 2010; Karadağ and Özkurt 2014). Acar et al. (2002) determined the plant height of the Jumbo cultivar as 231 cm in conditions of Konya. One of the main reasons for this difference may be the different sorghum plant varieties used in the study. Additionally, cultural and environmental factors such as ecological conditions, nitrogen doses, and irrigation factors can be associated with the variations observed between the studies.

In the study, it was found that chicken manure is more beneficial for sorghum and the sorghum-sudangrass hybrid, and it provides a similar yield in terms of leaf number compared to traditional nitrogen applications. Similarly, Amujoyegbe et al. (2007) and Agbede et al. (2008) reported that application of chicken manure increases the leaf area and improves morphological plant characteristics of forage sorghum. Although significant main effects of year, cultivar, and fertiliser application on leaf number were observed, their interactions were not statistically significant. This may be attributed to the inherent genetic stability of the sorghum cultivars (NES and Jumbo), which likely limited their responsiveness to variations in environmental conditions and fertiliser treatments. Moreover, the relatively consistent environmental conditions during the study period may have further minimised interaction effects.

The highest fresh forage yield was obtained from the Jumbo cultivar and applied with chicken manure and traditional nitrogen fertilisers. Similarly, Delate and Combardella (2000) reported that the forage yield obtained from organic fertilisers grown maize plants is higher compared to the traditional nitrogen application. Khaliq et al. (2000) found that the application of chicken manure and urea mixture showed the best performance among all fertiliser (cattle manure, chicken manure, and urea mixture) applications. Spargo et al. (2016) reported that the application of chicken litter fertilisers provides significant economic benefits. In the fertiliser treatment, the highest hay yield was obtained from chicken manure and from the traditional nitrogen application. Additionally, sheep manure, vermicompost manure, and gyttja organic fertiliser were statistically the same group. The reason for obtaining it from chicken manure can be attributed to the pellet structure of chicken manure, which requires a longer time for its dissolution compared to other organic fertilisers. The higher hay and forage yields observed under chicken manure application can be explained by the slow release of essential nutrients, notably nitrogen, throughout the growing season, supporting prolonged vegetative growth. Furthermore, the positive effects of chicken manure on soil structure, organic matter content, and microbial biomass likely enhanced nutrient availability and water retention, leading to improved biomass accumulation compared to conventional nitrogen fertiliser. Similarly, Nazlı (2011) reported that organic fertilisers are slow-release fertilisers, and approximately 50% of the nitrogen in the waste can become available to the plant in the first season. Therefore, it should be noted that the remaining portion will become suitable for the next crop and should not be overlooked. However, it has been determined that there is an approximate loss of 395 kg da^{-1} in hay yield in the area where cattle manure is applied instead of chicken manure. This loss is significant both for livestock enterprises and operational costs. It was also observed that cattle manure resulted in the lowest hay yield. Similarly, Khan et al. (2008) noted that in maize cultivation, the use of three times more cattle manure yielded lower productivity compared to 10 t ha^{-1} poultry manure. Basso et al. (2017) stated that instead of NPK usage, pig compost and chicken manure can be used as alternative organic fertilisers. However, Lim et al. (2010) determined that the highest dry matter yield in sorghum × sudangrass plants was obtained through chemical fertiliser application. Arslan found that high yields cannot be achieved with organic fertilisers. The cultivar of plants, the sowing rate, the fertiliser dosage, and the fertiliser source can be associated with the differences observed among the findings.

The DM important value is for forage productivity. McDonald et al. (1991) reported that the high moisture content of fresh material is considered to increase fermentation of undesirable microorganisms, especially clostridium, which would result in the nutrition loss of effluent and spoilage during the ensiling process. Açıkgöz (1995) impressed that a high-quality silage should have a dry material ratio of 23.5%. Although the DM content of Nes silage sorghum was at the desired level, it was determined that the DM content of Jumbo silage x sudanotu hybrid was low. The DM content related to the vegetation period. When sorghum and maize plants are harvested in early periods of vegetation, it is known that the plants have a high water content, low carbohydrate and DM content, and with the progress of harvest time, the rate of DM is also expected to increase (Şahan, 2017). The highest DM (T_0, T_{60}) value was obtained from the Nes cultivator, which implies that silage can be made easier. Akbay et al. (2023) reported that the content of DM can affect the initial pH and resulting pH values of silages. Researchers impress that the initial pH increased with the increased content of DM, but high DM content contributed to the achievement of a lower pH value as a result of fermentation. On the other hand, maybe Nes cultivator has a high content of water-soluble carbohydrates (WSC), resulting in contributing to low pH. Results showed that organic fertiliser applications do not affect the initial pH of silage, and the silages presented similar pH values. However, the differences between the pH values of the sorghum varieties are statistically significant. Similarly, it has been determined that the initial pH of the Nes (5.56) species with a high DM is higher compared to the Jumbo (5.53) variety (Akbay et al., 2023). The highest pH was obtained from the Jumbo cultivar with 4.33, while the lowest was found from the Nes cultivar with 4.07. The pH (T_{60}) value differed between fertiliser treatments and was generally lower for manure treatment than for the sheep manure and inorganic fertiliser treatments; this may also have affected the microorganism count. The lactic acid bacteria (LAB) are responsible for lowering the pH in silages and preserving the nutrient content for a long time, so LAB sees its key task for silage (Ávila and Carvalho 2020). LAB is found in epiphytic flora on plant material. However, its main source is soil (Kızılşimşek et al. 2016), so any application to the soil can change the density of the microorganism. This can also directly affect the direction of fermentation, the number of microorganisms, and microorganism variety. Pahlow et al. (2003) reported that the plant type of the amount of lactic acid bacteria and that the plant may change according to the state of maturity, and were determined corn and maize between 10^1 and 10^7 cfu/g fresh material. The count of lactic acid bacteria was similar among organic fertiliser treatments in resulting silage. In addition, a higher number of LAB in 2021 may be associated with a higher DM content. da Silva et al. (2017) reported that advancing crop maturity results in increases in DM, carbohydrates, and LAB populations, as well as microorganism numbers. Özdüven et al. (2009) found that the LAB count varied between 4.63 and 5.44 $\log_{10}$ cfu/g, resulting in silage of different maize varieties. Kaya and Polat (2010) reported that the LAB density of the maize varieties varied between 2.9-4.1 $\log_{10}$ cfu/g resulting in silage. At the beginning of the silage period, the highest number of yeast in the Nes variety is noticed. This condition is a bonding of the species Nes, so that the content of WSC is higher and provides the environment for the formation of lactic acid bacteria. This reduces the number of undesirable microorganisms. In addition, Müller (2009) impressed that above 40% DM, reduction in water activity could reduce the growth of yeast. Yeasts convert sugars and lactic acid basically to ethanol, resulting in losses of DM and nutrients. Moreover, a smaller amount of yeasts lowers the risks of aerobic spoilage, because these microorganisms have been shown to be initiators of this process (McDonald et al. 1991). Kızılşimşek et al. (2016) found that according to the opening time and isolations of silage, the number of yeast varied between 1.79-5.99 $\log_{10}$ cfu/g. Koç et al. (2018) informed us that the number of yeasts in corn silages varied between 4.29 and 5.60 $\log_{10}$ cfu/g. The difference between the results of silage construction, technique, and the plant used from their species.

This linearly increasing CP content in the silage is explained by the fact that chicken manure. In addition, there was no difference between the CP values of the sorghum varieties, but there is a statistically significant difference between OM and ash content. Jumbo cultivars presented higher ash content, probably because of the higher ratio of leaf to stem. Akbay et al. (2020) reported that changes in ash content may also be due to the change in proportion of leaf to stem ratio. Researchers also reported that ash content decreased with increasing maturity. Therefore, the decrease in the amount of ash in 2021 can be associated with the DM content. The lowest NDF and ADF content has been detected in the Nes cultivar. DM has a significant effect on the digestibility of silage nutrients, especially non-volatile nitrogen compounds and raw fibre (Podkówka 1995). In fact, increased DM content has also been shown in many studies to reduce digestibility. Podkówka et al. (2001) found that the highest digestibility in the plant occurs when the percentage of DM reaches 30%, and the digestibility decreases due to the delay in harvesting. Despite the fact that the DM content of the Nes is higher than that of the Jumbo, it has been determined that the NDF and ADF content is lower than the Nes. Decreasing NDF and ADF in the Nes sorghum variety can be associated with swing bonding. Similarly, Filya (2004) reported that NDF content decreased with maturity in the whole crop maize, which was associated with an increase in ADL and a decrease in CP contents. Filya (2001) showed that lower NDF led to higher DM and OM degradability. Because of these characteristics, it can be said that the Nes variety is advantageous.

According to the varieties, condensed tannin content varied between 0.64% and 1.31%, and the highest CT content was obtained from the Nes variety. Tannins might be associated with adverse effects as an anti-nutritional factor, causing lower dry matter intake and reduced digestion of protein and fibre. The low amount of tannins has an inhibitory effect on swelling in animals, so feed sources containing condensed tannins and tannins can be prevented from the economic losses caused by parasites by participating in the diet in certain proportions. Therefore, it is stated that the TMR to be included in the ration should be known as the contents (Kamalak et al. 2005). It is known that between 2% and 3% of the CT in the forage prevents swelling in ruminant animals, while the level of CT above 5% has a toxic effect, which reduces the consumption of feed and, consequently, the digestibility of protein (Barry and Blaney 1987). Nes and Jumbo silage sorghum varieties can be said to have CT content within acceptable limits and can be used in ruminant animal nutrition.

Conclusions

According to the research results, the highest plant height, fresh forage yield, and hay yield were obtained from the application of chicken manure. Similar results were obtained between organic fertilisers and traditional nitrogen application (NPK) in terms of stem ratio. However, when it comes to leaf ratio, lower values were obtained with the use of organic fertilisers compared to the traditional nitrogen application (NPK). It has been determined that chicken manure stands out more than other organic fertiliser treatments for silage sorghum cultivation, but it cannot provide sufficient nitrogen for the cluster ratio of the plant. It has been determined that there are significant differences in the varieties in terms of microflora numbers, fermentation properties, and silage quality, and the Nes variety stands out with its high dry matter content and low pH value. Additionally, it was determined that there was no difference between the CP values of the varieties, but the Nes variety had lower NDF and ADF values. For this reason, it was determined that the Nes variety was more prominent in terms of silage fermentation and silage quality.

In this context, increasing doses of chicken manure should be investigated for silage sorghum plants. Additionally, a combination of chicken manure and chemical fertiliser can be applied, or chicken manure doses can be split and applied according to the growth stages of the plant. According to the obtained results, it has been determined that the Jumbo cultivar is more productive than the Nes cultivar. The Jumbo cultivar is recommended for Kahramanmaras province and similar ecological conditions. Future studies should be conducted under varying climatic and soil conditions, including economic feasibility assessments, to validate and expand upon the current findings and support region-specific fertiliser recommendations for sorghum cultivation.

Disclosure statement

No potential conflict of interest was reported by the author(s).

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AKADEMİK PERFORMANS DEĞERLENDİRME RAPORU

Yıl:	2025
Akademisyen Adı Soyadı:	ADEM EROL
Birim:	Ziraat Fakültesi Dekanlığı
Bölüm:	Tarla Bitkileri Bölüm Başkanlığı
Kategori:	Toplantı ve Eğitim
Faaliyet:	Genel Eğitim
Kapsam:	Yüksek lisans danışmanlık
Başlangıç Tarihi:	01.01.2025
Bitiş Tarihi:	01.12.2025
Performans:	Lisans danışmanlığı yapmış olmak
Puan:	8,00
Kanıt Dosya Sayısı:	1

Tarama sonucunda 10 kayıt bulundu.

No	Tez No	Yazar	Yıl	Tez Adı (Orijinal/Çeviri)	Tez Türü	Konu
		Filtrele	2000..2014 =2(	Filtrele	Filtrele	Filtrele
1	973365	MUSTAFA ARSLAN	2025	Kahramanmaraş ekolojğk koşullarında yaygın fiğ (Vicia sativa l.) ile yerel çavdarın (S5ecale cereale) farklı oranlardakarışımlarının bitkisel özellikler ve ot kalitesi üzerine etkileri *Effects on plant characters and forage quality of common vetch (Vicia sativa L.) and local rye (Secale cerale) mixtures in Kahramanmaraş ecological conditions*	Yüksek Lisans	Ziraat = Agriculture
2	473118	FATMA AKBAY	2017	Farklı çemen genotiplerinin morfolojik ve tarımsal özellikleri yönünden değerlendirilmesi *Determine morphologic and agronomic characteristics of different fenugreek genotypes*	Yüksek Lisans	Ziraat = Agriculture
3	426774	GÖKHAN OSMAN CENGİZ	2016	Kahramanmaraş koşullarında bazı mürdümük hat ve çeşitlerinin tarımsal özelliklerinin belirlenmesi *Identification of agricultural characteristics of certain lines and species of grasspea in kahramanmaraş conditions*	Yüksek Lisans	Ziraat = Agriculture
4	436312	RUKİYE DÖNMEZ	2016	Kahramanmaraş koşullarında bazı silajlık mısır çeşitlerinin verim ve verim özellikleri üzerine araştırmalar *Studies on silage yield and yield components of some hybred corn cultivars on Kahramanmaras ecological conditions*	Yüksek Lisans	Ziraat = Agriculture
5	426771	MERAL ARIKAN	2016	Bazı adi fiğ (Vicia sativa L.) genotiplerinde tohum verimi ve bazı tarımsal karakterlerin incelenmesi *Evaluating of seed yield and some agronomic characters of some common vetch (Vicia sativa L.) genotypes*	Yüksek Lisans	Ziraat = Agriculture
6	309155	MEHMET FATİH YILMAZ	2011	Bazı adi fiğ (Vicia sativa L.) genotiplerinde verim ve verim unsurları ile kalite özelliklerinin belirlenmesi *Determination of yield, yield components and some quality characters of some common vetch (Vicia sativa L.) genotypes*	Doktora	Ziraat = Agriculture
7	269208	SERCAN ÇELİK	2010	Kahramanmaraş koşullarında bazı tahıl türleri ile adi fiğin (Vicia sativa L.) farklı karışım oranlarının ot verimi ve kalitesi üzererine etkileri *Research on the effects of hay yield and hay quality of some grain types + vetch mixtures to be grown under conditions of Kahramanmaraş*	Yüksek Lisans	Ziraat = Agriculture
8	169925	MEHMET KIRLAR	2005	Kahramanmaraş koşullarında bazı burçak (Vicia ervilia (L.) Wild) hatlarının ot verimi ve verimle ilişkili özelliklerinin saptanması üzerine bir araştırma *A research on determination of herbage yield end yield component of some vetch (Vicia ervilia (L.) Wild) lines originated from icarda under Kahramanmaraş ecological conditions*	Yüksek Lisans	Ziraat = Agriculture
9	169926	NERİMAN AVCI	2005	Farklı fosfor dozlarının bazı fiğ türlerinin verim ve verimle ilgili özelliklerine etkisi *Effect on seed yield and agricultural characteristics of different phosphorus doses in three vecth varietes*	Yüksek Lisans	Ziraat = Agriculture
10	120766	NASFİYE GENÇ	2002	Kahramanmaraş koşullarında bazı burçak (Vicia ervilia (L) willd) hatlarında farklı sıra arası mesafelerin tohum verimi ve diğer tarımsal özelliklere etkisi üzerine bir araştırma *A Research on the effect of row spacing to seed yield and agricultural characters of some bitter vetch (Vicia ervilia (L) willd) cultivars for Kahramanmaraş conditions*	Yüksek Lisans	Ziraat = Agriculture

Satırlar(Rows) 1-10 of 10

« 1 2 3 4 5 » Satırlar(Rows) ▲ Sütunlar(Columns) ▲

AKADEMİK PERFORMANS DEĞERLENDİRME RAPORU

Yıl:	2025
Akademisyen Adı Soyadı:	ADEM EROL
Birim:	Ziraat Fakültesi Dekanlığı
Bölüm:	Tarla Bitkileri Bölüm Başkanlığı
Kategori:	Toplantı ve Eğitim
Faaliyet:	Genel Eğitim
Kapsam:	Botanik
Başlangıç Tarihi:	01.01.2025
Bitiş Tarihi:	01.12.2025
Performans:	Lisans ders verme
Puan:	5,00
Kanıt Dosya Sayısı:	1

2025 GÜZ VERİLEN DERSLER.html

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- Ders İşlemleri
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  - Derslik Ders Programı
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- Danışmanlık İşlemleri
- Sınav İşlemleri
- Akademik CV
- Hazırlık İşlemleri
- Başvuru İşlemleri
- Kullanıcı İşlemleri

2025-2026 Güz

Doç.Dr. ADEM EROL

Öğretim Elemanı Ders Programı

Doç.Dr. ADEM EROL

Dönem 2025-2026 Güz

Yazdır

Pazartesi

Saat	Ders Kodu	Ders Adı	Derslik
13:00-13:45	BZF105(1)	BOTANİK I	ZF-D2-ED-Z-2[50]
14:00-14:45	BZF105(1)	BOTANİK I	ZF-D2-ED-Z-2[50]
15:00-15:45	BZF105(1)	BOTANİK I	ZF-D2-ED-Z-2[50]
16:00-16:45	BZF105(1)	BOTANİK I	ZF-D2-ED-Z-2[50]

Salı

Saat	Ders Kodu	Ders Adı	Derslik
09:15-10:00	TBZ5001(1)	YEM BİTKİLERİNDE KALİTE VE KALİTEYİ ETKİLEYEN FAK	TB10[40]
10:15-11:00	TBZ5001(1)	YEM BİTKİLERİNDE KALİTE VE KALİTEYİ ETKİLEYEN FAK	TB10[40]
11:15-12:00	TBZ5001(1)	YEM BİTKİLERİNDE KALİTE VE KALİTEYİ ETKİLEYEN FAK	TB10[40]
17:00-17:45	BTB411(1)	MEZUNİYET ÇALIŞMASI I	ZF-D2-ED-K2-8[57]
18:00-18:45	BTB411(1)	MEZUNİYET ÇALIŞMASI I	ZF-D2-ED-K2-8[57]

Çarşamba

Tanımlı Ders Programı Bulunamadı!

Perşembe

Saat	Ders Kodu	Ders Adı	Derslik
13:00-13:45	BTB303(1)	YEM BİTKİLERİ	ZF-D1-ED-K2-4[50]
14:00-14:45	BTB303(1)	YEM BİTKİLERİ	ZF-D1-ED-K2-4[50]
15:00-15:45	BTB303(1)	YEM BİTKİLERİ	ZF-D1-ED-K2-4[50]
16:00-16:45	BTB303(1)	YEM BİTKİLERİ	ZF-D1-ED-K2-4[50]

Cuma

Saat	Ders Kodu	Ders Adı	Derslik
08:15-09:00	UAD9001(Z-2924)	Lisansüstü Uzmanlık Alan Dersi I	TB10[40]
09:15-10:00	UAD9001(Z-2924)	Lisansüstü Uzmanlık Alan Dersi I	TB10[40]
10:15-11:00	UAD9001(Z-2924)	Lisansüstü Uzmanlık Alan Dersi I	TB10[40]
11:15-12:00	UAD9001(Z-2924)	Lisansüstü Uzmanlık Alan Dersi I	TB10[40]
13:00-13:45	UAD9001(Z-2924)	Lisansüstü Uzmanlık Alan Dersi I	TB10[40]
14:00-14:45	UAD9001(Z-2924)	Lisansüstü Uzmanlık Alan Dersi I	TB10[40]
15:00-15:45	UAD9001(Z-2924)	Lisansüstü Uzmanlık Alan Dersi I	TB10[40]
16:00-16:45	UAD9001(Z-2924)	Lisansüstü Uzmanlık Alan Dersi I	TB10[40]

Cumartesi

Saat	Ders Kodu	Ders Adı	Derslik
10:15-11:00	SEM7701(Z-2924)	SEMİNER	TB10[40]

Ofis Danışmanlık Saatleri

Gün	Başlangıç Saati	Bitiş Saati	Açıklamalar
Pazartesi	08:00	17:00	

Not: Uygulama saatleri yeşil renkle gösterilir

(E-Devlet ile giriş yapıldı)

12:27
6.12.2025

AKADEMİK PERFORMANS DEĞERLENDİRME RAPORU

Yıl:	2025
Akademisyen Adı Soyadı:	ADEM EROL
Birim:	Ziraat Fakültesi Dekanlığı
Bölüm:	Tarla Bitkileri Bölüm Başkanlığı
Kategori:	Toplantı ve Eğitim
Faaliyet:	Genel Eğitim
Kapsam:	Yem Bitkileri
Başlangıç Tarihi:	01.01.2025
Bitiş Tarihi:	01.12.2025
Performans:	Lisans ders verme
Puan:	5,00
Kanıt Dosya Sayısı:	1

2025-2026 Güz

Doç.Dr. ADEM EROL

Öğretim Elemanı Ders Programı

Doç.Dr. ADEM EROL

Dönem 2025-2026 Güz

Yazdır

Pazartesi

Saat	Ders Kodu	Ders Adı	Derslik
13:00-13:45	BZF105(1)	BOTANİK I	ZF-D2-ED-Z-2[50]
14:00-14:45	BZF105(1)	BOTANİK I	ZF-D2-ED-Z-2[50]
15:00-15:45	BZF105(1)	BOTANİK I	ZF-D2-ED-Z-2[50]
16:00-16:45	BZF105(1)	BOTANİK I	ZF-D2-ED-Z-2[50]

Salı

Saat	Ders Kodu	Ders Adı	Derslik
09:15-10:00	TBZ5001(1)	YEM BİTKİLERİNDE KALİTE VE KALİTEYİ ETKİLEYEN FAK	TB10[40]
10:15-11:00	TBZ5001(1)	YEM BİTKİLERİNDE KALİTE VE KALİTEYİ ETKİLEYEN FAK	TB10[40]
11:15-12:00	TBZ5001(1)	YEM BİTKİLERİNDE KALİTE VE KALİTEYİ ETKİLEYEN FAK	TB10[40]
17:00-17:45	BTB411(1)	MEZUNİYET ÇALIŞMASI I	ZF-D2-ED-K2-8[57]
18:00-18:45	BTB411(1)	MEZUNİYET ÇALIŞMASI I	ZF-D2-ED-K2-8[57]

Çarşamba

Tanımlı Ders Programı Bulunamadı!

Perşembe

Saat	Ders Kodu	Ders Adı	Derslik
13:00-13:45	BTB303(1)	YEM BİTKİLERİ	ZF-D1-ED-K2-4[50]
14:00-14:45	BTB303(1)	YEM BİTKİLERİ	ZF-D1-ED-K2-4[50]
15:00-15:45	BTB303(1)	YEM BİTKİLERİ	ZF-D1-ED-K2-4[50]
16:00-16:45	BTB303(1)	YEM BİTKİLERİ	ZF-D1-ED-K2-4[50]

Cuma

Saat	Ders Kodu	Ders Adı	Derslik
08:15-09:00	UAD9001(Z-2924)	Lisansüstü Uzmanlık Alan Dersi I	TB10[40]
09:15-10:00	UAD9001(Z-2924)	Lisansüstü Uzmanlık Alan Dersi I	TB10[40]
10:15-11:00	UAD9001(Z-2924)	Lisansüstü Uzmanlık Alan Dersi I	TB10[40]
11:15-12:00	UAD9001(Z-2924)	Lisansüstü Uzmanlık Alan Dersi I	TB10[40]
13:00-13:45	UAD9001(Z-2924)	Lisansüstü Uzmanlık Alan Dersi I	TB10[40]
14:00-14:45	UAD9001(Z-2924)	Lisansüstü Uzmanlık Alan Dersi I	TB10[40]
15:00-15:45	UAD9001(Z-2924)	Lisansüstü Uzmanlık Alan Dersi I	TB10[40]
16:00-16:45	UAD9001(Z-2924)	Lisansüstü Uzmanlık Alan Dersi I	TB10[40]

Cumartesi

Saat	Ders Kodu	Ders Adı	Derslik
10:15-11:00	SEM7701(Z-2924)	SEMİNER	TB10[40]

Ofis Danışmanlık Saatleri

Gün	Başlangıç Saati	Bitiş Saati	Açıklamalar
Pazartesi	08:00	17:00	

Not: Uygulama saatleri yeşil renkle gösterilir

AKADEMİK PERFORMANS DEĞERLENDİRME RAPORU

Yıl:	2025
Akademisyen Adı Soyadı:	ADEM EROL
Birim:	Ziraat Fakültesi Dekanlığı
Bölüm:	Tarla Bitkileri Bölüm Başkanlığı
Kategori:	Bilimsel Etkinlik Katılımı
Faaliyet:	Ders
Kapsam:	Bahar 2025 dersleri
Başlangıç Tarihi:	01.01.2025
Bitiş Tarihi:	01.12.2025
Performans:	Kurum dışı ders/kurs/eğitim verme faaliyetinde bulunmak
Puan:	5,00
Kanıt Dosya Sayısı:	0

AKADEMİK PERFORMANS DEĞERLENDİRME RAPORU

Yıl:	2025
Akademisyen Adı Soyadı:	ADEM EROL
Birim:	Ziraat Fakültesi Dekanlığı
Bölüm:	Tarla Bitkileri Bölüm Başkanlığı
Kategori:	Toplantı ve Eğitim
Faaliyet:	Genel Eğitim
Kapsam:	Çayır mera ve yembitkileri
Başlangıç Tarihi:	02.02.2025
Bitiş Tarihi:	01.12.2025
Performans:	Lisans ders verme
Puan:	5,00
Kanıt Dosya Sayısı:	0

AKADEMİK PERFORMANS DEĞERLENDİRME RAPORU

Yıl:	2025
Akademisyen Adı Soyadı:	ADEM EROL
Birim:	Ziraat Fakültesi Dekanlığı
Bölüm:	Tarla Bitkileri Bölüm Başkanlığı
Kategori:	Diğer
Faaliyet:	Uygulama
Kapsam:	Çayır mera ve yembitkileri
Başlangıç Tarihi:	01.01.2025
Bitiş Tarihi:	01.12.2025
Performans:	Lisans ders verme
Puan:	5,00
Kanıt Dosya Sayısı:	1

2025 BAHAR VERİLEN DERSLER.ht ×

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Oturum aç | Sohbet et

Kahramanmaraş Sütçü İmam Üniversitesi

Akademik Bilgi Sistemi

- Ders İşlemleri
  - Kullanım Kılavuzu
  - Akademik Takvim
  - Verilen Dersler
  - Mobil Yoklama İşlemleri
  - Derslik Ders Programı
  - Ders Programı
  - Tıp Fakültesi Ders Programı
  - Değerlendirme Form Sonuçları
  - Ders Bilgi Paketi Tanımları
  - Araştırma Konuları
- Danışmanlık İşlemleri
- Sınav İşlemleri
- Akademik CV
- Hazırlık İşlemleri
- Başvuru İşlemleri
- Kullanıcı İşlemleri

2025-2026 Güz

Doç.Dr. ADEM EROL

Liste Seçenekleri.

Verilen Ders Dönemi: 2024-2025 Bahar

Fakülte Türü: Tümü

Kontenjan Göster

Ders Kodu

Ders Adı

Öğrenci No

Öğrenci Ad Soyad

Listele

Verilen Dersler | Danışmanı Olarak Verilen Dersler

#	Dönem	Şb	Ders Kodu	Ders Adı	Ders Dili	T+U	Z	Krd	AKTS	Fakülte	Program	#				#
	2024-2025 Bahar	1	TBZ5002	BAKLAGİL YEM BİTKİLERİNDE AZOT FİKSASYONUNUN MEKAN	Türkçe	3+0		3	6	FENBE	Tarla Bitkileri	Ek İşlemler				
	2024-2025 Bahar	1	BZT3026	ÇAYIR-MERA VE YEM BİTKİLERİ (SEÇ.)	Türkçe	2+2		3	3	ZIRF	Zootek.	Ek İşlemler				
	2024-2025 Bahar	1	BZT218	ÇAYIR-MERA VE YEM BİTKİLERİ (SEÇ.)	Türkçe	2+2		3	4	ZIRF	Zootek.	Ek İşlemler				
	2024-2025 Bahar	1	BTB308	MESLEKİ UYGULAMA II	Türkçe	0+4	□	0	2	ZIRF	Tar. Bit.	Ek İşlemler				
	2024-2025 Bahar	Z-2924	SEM7700	SEMİNER	Türkçe	0+0		0	6	FENBE	Tarla Bitkileri	Ek İşlemler				
	2024-2025 Bahar	1	BTB350	STAJ	Türkçe	0+0	□	0	11	ZIRF	Tar. Bit.	Ek İşlemler				
	2024-2025 Bahar	1	BTE226	TARLA BİTKİLERİ	Türkçe	2+2	□	3	4	ZIRF	Tar. Eko.	Ek İşlemler				
	2024-2025 Bahar	1	TBZ5000	YEM BİTKİLERİ TOHUMCULUĞU	Türkçe	3+0		3	6	FENBE	Tarla Bitkileri	Ek İşlemler				
	2024-2025 Bahar	Z-2924	YTZ7600	YÜKSEK LİSANS TEZ ÇALIŞMASI II	Türkçe	0+0		0	24	FENBE	Tarla Bitkileri	Ek İşlemler				
	2024-2025 Bahar	Z-2924	UZY7500	YÜKSEK LİSANS UZMANLIK ALAN DERSİ II	Türkçe	4+0		4	6	FENBE	Tarla Bitkileri	Ek İşlemler				

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Renk Açıklamaları

Verilen Ders | Alt Kurul için Verilen Ders | Alt Kurul Ders Program | Dersin Diğer Öğretim Elemanı Olarak Verilen Ders | Yoklama Girişi ve Not Girişi Yetkiniz Yok

Windows'u Etkinleştir
Windows'u etkinleştirmek için Ayarlar'a gidin.

(E-Devlet ile giriş yapıldı)

www.prolizyazilim.com

javascript:__doPostBack('grdDersler$ctl04$btnToggle','')

12:25
6.12.2025

AKADEMİK PERFORMANS DEĞERLENDİRME RAPORU

Yıl:	2025
Akademisyen Adı Soyadı:	ADEM EROL
Birim:	Ziraat Fakültesi Dekanlığı
Bölüm:	Tarla Bitkileri Bölüm Başkanlığı
Kategori:	Diğer
Faaliyet:	Uygulama
Kapsam:	Tarla Bitkileri dersi
Başlangıç Tarihi:	01.01.2025
Bitiş Tarihi:	01.12.2025
Performans:	Lisans ders verme
Puan:	5,00
Kanıt Dosya Sayısı:	1

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Oturum aç Sohbet et

Kahramanmaraş Sütçü İmam Üniversit

Akademik Bilgi Sistemi

- Ders İşlemleri
  - Kullanım Kılavuzu
  - Akademik Takvim
  - Verilen Dersler
  - Mobil Yoklama İşlemleri
  - Derslik Ders Programı
  - Ders Programı
  - Tıp Fakültesi Ders Programı
  - Değerlendirme Form Sonuçları
  - Ders Bilgi Paketi Tanımları
  - Araştırma Konuları
- Danışmanlık İşlemleri
- Sınav İşlemleri
- Akademik CV
- Hazırlık İşlemleri
- Başvuru İşlemleri
- Kullanıcı İşlemleri

2025-2026 Güz

Doç.Dr. ADEM EROL

Liste Seçenekleri.

Verilen Ders Dönemi: 2024-2025 Bahar

Fakülte Türü: Tümü

Kontenjan Göster

Ders Kodu

Ders Adı

Öğrenci No

Öğrenci Ad Soyad

Listele

Verilen Dersler | Danışmanı Olarak Verilen Dersler

#	Dönem	Şb	Ders Kodu	Ders Adı	Ders Dili	T+U	Z	Krd	AKTS	Fakülte	Program	#	#
	2024-2025 Bahar	1	TBZ5002	BAKLAGİL YEM BİTKİLERİNDE AZOT FİKSASYONUNUN MEKAN	Türkçe	3+0		3	6	FENBE	Tarla Bitkileri	Ek İşlemler	
	2024-2025 Bahar	1	BZT3026	ÇAYIR-MERA VE YEM BİTKİLERİ (SEÇ.)	Türkçe	2+2		3	3	ZIRF	Zootek.	Ek İşlemler	
	2024-2025 Bahar	1	BZT218	ÇAYIR-MERA VE YEM BİTKİLERİ (SEÇ.)	Türkçe	2+2		3	4	ZIRF	Zootek.	Ek İşlemler	
	2024-2025 Bahar	1	BTB308	MESLEKİ UYGULAMA II	Türkçe	0+4	☐	0	2	ZIRF	Tar. Bit.	Ek İşlemler	
	2024-2025 Bahar	Z-2924	SEM7700	SEMİNER	Türkçe	0+0		0	6	FENBE	Tarla Bitkileri	Ek İşlemler	
	2024-2025 Bahar	1	BTB350	STAJ	Türkçe	0+0	☐	0	11	ZIRF	Tar. Bit.	Ek İşlemler	
	2024-2025 Bahar	1	BTE226	TARLA BİTKİLERİ	Türkçe	2+2	☐	3	4	ZIRF	Tar. Eko.	Ek İşlemler	
	2024-2025 Bahar	1	TBZ5000	YEM BİTKİLERİ TOHUMCULUĞU	Türkçe	3+0		3	6	FENBE	Tarla Bitkileri	Ek İşlemler	
	2024-2025 Bahar	Z-2924	YTZ7600	YÜKSEK LİSANS TEZ ÇALIŞMASI II	Türkçe	0+0		0	24	FENBE	Tarla Bitkileri	Ek İşlemler	
	2024-2025 Bahar	Z-2924	UZY7500	YÜKSEK LİSANS UZMANLIK ALAN DERSİ II	Türkçe	4+0		4	6	FENBE	Tarla Bitkileri	Ek İşlemler	

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Renk Açıklamaları

Verilen Ders | Alt Kurul için Verilen Ders | Alt Kurul Ders Program | Dersin Diğer Öğretim Elemanı Olarak Verilen Ders | Yoklama Girişi ve Not Girişi Yetkiniz Yok

(E-Devlet ile giriş yapıldı)

javascript:__doPostBack('grdDersler$ctl04$btnToggle','')

12:25
6.12.2025

AKADEMİK PERFORMANS DEĞERLENDİRME RAPORU

Yıl:	2025
Akademisyen Adı Soyadı:	ADEM EROL
Birim:	Ziraat Fakültesi Dekanlığı
Bölüm:	Tarla Bitkileri Bölüm Başkanlığı
Kategori:	Diğer
Faaliyet:	Uygulama
Kapsam:	Baklagil yem bitkilerinde Biyolojik Azot Fiksasyon Mekanizması ve önemi
Başlangıç Tarihi:	01.01.2025
Bitiş Tarihi:	01.12.2025
Performans:	Lisansüstü ders verme
Puan:	5,00
Kanıt Dosya Sayısı:	1

2025 BAHAR VERİLEN DERSLER.ht

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Oturum aç | Sohbet et

Kahramanmaraş Sütçü İmam Üniversitesi

Akademik Bilgi Sistemi

- Ders İşlemleri
  - Kullanım Kılavuzu
  - Akademik Takvim
  - Verilen Dersler
  - Mobil Yoklama İşlemleri
  - Derslik Ders Programı
  - Ders Programı
  - Tıp Fakültesi Ders Programı
  - Değerlendirme Form Sonuçları
  - Ders Bilgi Paketi Tanımları
  - Araştırma Konuları
- Danışmanlık İşlemleri
- Sınav İşlemleri
- Akademik CV
- Hazırlık İşlemleri
- Başvuru İşlemleri
- Kullanıcı İşlemleri

2025-2026 Güz

Doç.Dr. ADEM EROL

Liste Seçenekleri.

Verilen Ders Dönemi: 2024-2025 Bahar | Fakülte Türü: Tümü | Kontenjan Göster

Ders Kodu | Ders Adı

Öğrenci No | Öğrenci Ad Soyad | Listele

Verilen Dersler | Danışmanı Olarak Verilen Dersler

#	Dönem	Şb	Ders Kodu	Ders Adı	Ders Dili	T+U	Z	Krd	AKTS	Fakülte	Program	#
	2024-2025 Bahar	1	TBZ5002	BAKLAGİL YEM BİTKİLERİNDE AZOT FİKSASYONUNUN MEKAN	Türkçe	3+0		3	6	FENBE	Tarla Bitkileri	Ek İşlemler
	2024-2025 Bahar	1	BZT3026	ÇAYIR-MERA VE YEM BİTKİLERİ (SEÇ.)	Türkçe	2+2		3	3	ZIRF	Zootek.	Ek İşlemler
	2024-2025 Bahar	1	BZT218	ÇAYIR-MERA VE YEM BİTKİLERİ (SEÇ.)	Türkçe	2+2		3	4	ZIRF	Zootek.	Ek İşlemler
	2024-2025 Bahar	1	BTB308	MESLEKİ UYGULAMA II	Türkçe	0+4	☐	0	2	ZIRF	Tar. Bit.	Ek İşlemler
	2024-2025 Bahar	Z-2924	SEM7700	SEMİNER	Türkçe	0+0		0	6	FENBE	Tarla Bitkileri	Ek İşlemler
	2024-2025 Bahar	1	BTB350	STAJ	Türkçe	0+0	☐	0	11	ZIRF	Tar. Bit.	Ek İşlemler
	2024-2025 Bahar	1	BTE226	TARLA BİTKİLERİ	Türkçe	2+2	☐	3	4	ZIRF	Tar. Eko.	Ek İşlemler
	2024-2025 Bahar	1	TBZ5000	YEM BİTKİLERİ TOHUMCULUĞU	Türkçe	3+0		3	6	FENBE	Tarla Bitkileri	Ek İşlemler
	2024-2025 Bahar	Z-2924	YTZ7600	YÜKSEK LİSANS TEZ ÇALIŞMASI II	Türkçe	0+0		0	24	FENBE	Tarla Bitkileri	Ek İşlemler
	2024-2025 Bahar	Z-2924	UZY7500	YÜKSEK LİSANS UZMANLIK ALAN DERSİ II	Türkçe	4+0		4	6	FENBE	Tarla Bitkileri	Ek İşlemler

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Renk Açıklamaları

Verilen Ders | Alt Kurul için Verilen Ders | Alt Kurul Ders Program | Dersin Diğer Öğretim Elemanı Olarak Verilen Ders | Yoklama Girişi ve Not Girişi Yetkiniz Yok

(E-Devlet ile giriş yapıldı)

javascript:__doPostBack('grdDersler$ctl04$btnToggle','')

12:25
6.12.2025

AKADEMİK PERFORMANS DEĞERLENDİRME RAPORU

Yıl:	2025
Akademisyen Adı Soyadı:	ADEM EROL
Birim:	Ziraat Fakültesi Dekanlığı
Bölüm:	Tarla Bitkileri Bölüm Başkanlığı
Kategori:	Diğer
Faaliyet:	Uygulama
Kapsam:	Yembitkileri Tohumculuğu
Başlangıç Tarihi:	01.01.2025
Bitiş Tarihi:	01.12.2025
Performans:	Lisansüstü ders verme
Puan:	5,00
Kanıt Dosya Sayısı:	1

2025 BAHAR VERİLEN DERSLER.htı

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Oturum aç · Sohbet et

Kahramanmaraş Sütçü İmam Üniversitesi

Akademik Bilgi Sistemi

- Ders İşlemleri
  - Kullanım Kılavuzu
  - Akademik Takvim
  - Verilen Dersler
  - Mobil Yoklama İşlemleri
  - Derslik Ders Programı
  - Ders Programı
  - Tıp Fakültesi Ders Programı
  - Değerlendirme Form Sonuçları
  - Ders Bilgi Paketi Tanımları
  - Araştırma Konuları
- Danışmanlık İşlemleri
- Sınav İşlemleri
- Akademik CV
- Hazırlık İşlemleri
- Başvuru İşlemleri
- Kullanıcı İşlemleri

2025-2026 Güz · Doç.Dr. ADEM EROL

Liste Seçenekleri.

Verilen Ders Dönemi: 2024-2025 Bahar · Fakülte Türü: Tümü · Kontenjan Göster

Ders Kodu · Ders Adı

Öğrenci No · Öğrenci Ad Soyad · Listele

Verilen Dersler · Danışmanı Olarak Verilen Dersler

#	Dönem	Şb	Ders Kodu	Ders Adı	Ders Dili	T+U	Z	Krd	AKTS	Fakülte	Program	#				#
	2024-2025 Bahar	1	TBZ5002	BAKLAGİL YEM BİTKİLERİNDE AZOT FİKSASYONUNUN MEKAN	Türkçe	3+0		3	6	FENBE	Tarla Bitkileri	Ek İşlemler				
	2024-2025 Bahar	1	BZT3026	ÇAYIR-MERA VE YEM BİTKİLERİ (SEÇ.)	Türkçe	2+2		3	3	ZIRF	Zootek.	Ek İşlemler				
	2024-2025 Bahar	1	BZT218	ÇAYIR-MERA VE YEM BİTKİLERİ (SEÇ.)	Türkçe	2+2		3	4	ZIRF	Zootek.	Ek İşlemler				
	2024-2025 Bahar	1	BTB308	MESLEKİ UYGULAMA II	Türkçe	0+4	☐	0	2	ZIRF	Tar. Bit.	Ek İşlemler				
	2024-2025 Bahar	Z-2924	SEM7700	SEMİNER	Türkçe	0+0		0	6	FENBE	Tarla Bitkileri	Ek İşlemler				
	2024-2025 Bahar	1	BTB350	STAJ	Türkçe	0+0	☐	0	11	ZIRF	Tar. Bit.	Ek İşlemler				
	2024-2025 Bahar	1	BTE226	TARLA BİTKİLERİ	Türkçe	2+2	☐	3	4	ZIRF	Tar. Eko.	Ek İşlemler				
	2024-2025 Bahar	1	TBZ5000	YEM BİTKİLERİ TOHUMCULUĞU	Türkçe	3+0		3	6	FENBE	Tarla Bitkileri	Ek İşlemler				
	2024-2025 Bahar	Z-2924	YTZ7600	YÜKSEK LİSANS TEZ ÇALIŞMASI II	Türkçe	0+0		0	24	FENBE	Tarla Bitkileri	Ek İşlemler				
	2024-2025 Bahar	Z-2924	UZY7500	YÜKSEK LİSANS UZMANLIK ALAN DERSİ II	Türkçe	4+0		4	6	FENBE	Tarla Bitkileri	Ek İşlemler				

10 - 1/1 · 1

Renk Açıklamaları

Verilen Ders · Alt Kurul için Verilen Ders · Alt Kurul Ders Program · Dersin Diğer Öğretim Elemanı Olarak Verilen Ders · Yoklama Girişi ve Not Girişi Yetkiniz Yok

Windows'u Etkinleştir
Windows'u etkinleştirmek için Ayarlar'a gidin.

(E-Devlet ile giriş yapıldı)

www.prolizyazilim.com

javascript:__doPostBack('grdDersler$ctl04$btnToggle','')

12:25
6.12.2025

AKADEMİK PERFORMANS DEĞERLENDİRME RAPORU

Yıl:	2025
Akademisyen Adı Soyadı:	ADEM EROL
Birim:	Ziraat Fakültesi Dekanlığı
Bölüm:	Tarla Bitkileri Bölüm Başkanlığı
Kategori:	Toplantı ve Eğitim
Faaliyet:	Genel Eğitim
Kapsam:	Yembitkilerinde kalite ve kaliteyi etkileyen faktörler
Başlangıç Tarihi:	01.09.2025
Bitiş Tarihi:	15.01.2026
Performans:	Lisansüstü ders verme
Puan:	6,00
Kanıt Dosya Sayısı:	1

Kahramanmaraş Sütçü İmam Üniversit

Akademik Bilgi Sistemi

- Ders İşlemleri
  - Kullanım Kılavuzu
  - Akademik Takvim
  - Verilen Dersler
  - Mobil Yoklama İşlemleri
  - Derslik Ders Programı
  - Ders Programı
  - Tıp Fakültesi Ders Programı
  - Değerlendirme Form Sonuçları
  - Ders Bilgi Paketi Tanımları
  - Araştırma Konuları
- Danışmanlık İşlemleri
- Sınav İşlemleri
- Akademik CV
- Hazırlık İşlemleri
- Başvuru İşlemleri
- Kullanıcı İşlemleri

2025-2026 Güz

Doç.Dr. ADEM EROL

Öğretim Elemanı Ders Programı

Doç.Dr. ADEM EROL

Dönem 2025-2026 Güz

Yazdır

Pazartesi

Saat	Ders Kodu	Ders Adı	Derslik
13:00-13:45	BZF105(1)	BOTANİK I	ZF-D2-ED-Z-2[50]
14:00-14:45	BZF105(1)	BOTANİK I	ZF-D2-ED-Z-2[50]
15:00-15:45	BZF105(1)	BOTANİK I	ZF-D2-ED-Z-2[50]
16:00-16:45	BZF105(1)	BOTANİK I	ZF-D2-ED-Z-2[50]

Salı

Saat	Ders Kodu	Ders Adı	Derslik
09:15-10:00	TBZ5001(1)	YEM BİTKİLERİNDE KALİTE VE KALİTEYİ ETKİLEYEN FAK	TB10[40]
10:15-11:00	TBZ5001(1)	YEM BİTKİLERİNDE KALİTE VE KALİTEYİ ETKİLEYEN FAK	TB10[40]
11:15-12:00	TBZ5001(1)	YEM BİTKİLERİNDE KALİTE VE KALİTEYİ ETKİLEYEN FAK	TB10[40]
17:00-17:45	BTB411(1)	MEZUNİYET ÇALIŞMASI I	ZF-D2-ED-K2-8[57]
18:00-18:45	BTB411(1)	MEZUNİYET ÇALIŞMASI I	ZF-D2-ED-K2-8[57]

Çarşamba

Tanımlı Ders Programı Bulunamadı!

Perşembe

Saat	Ders Kodu	Ders Adı	Derslik
13:00-13:45	BTB303(1)	YEM BİTKİLERİ	ZF-D1-ED-K2-4[50]
14:00-14:45	BTB303(1)	YEM BİTKİLERİ	ZF-D1-ED-K2-4[50]
15:00-15:45	BTB303(1)	YEM BİTKİLERİ	ZF-D1-ED-K2-4[50]
16:00-16:45	BTB303(1)	YEM BİTKİLERİ	ZF-D1-ED-K2-4[50]

Cuma

Saat	Ders Kodu	Ders Adı	Derslik
08:15-09:00	UAD9001(Z-2924)	Lisansüstü Uzmanlık Alan Dersi I	TB10[40]
09:15-10:00	UAD9001(Z-2924)	Lisansüstü Uzmanlık Alan Dersi I	TB10[40]
10:15-11:00	UAD9001(Z-2924)	Lisansüstü Uzmanlık Alan Dersi I	TB10[40]
11:15-12:00	UAD9001(Z-2924)	Lisansüstü Uzmanlık Alan Dersi I	TB10[40]
13:00-13:45	UAD9001(Z-2924)	Lisansüstü Uzmanlık Alan Dersi I	TB10[40]
14:00-14:45	UAD9001(Z-2924)	Lisansüstü Uzmanlık Alan Dersi I	TB10[40]
15:00-15:45	UAD9001(Z-2924)	Lisansüstü Uzmanlık Alan Dersi I	TB10[40]
16:00-16:45	UAD9001(Z-2924)	Lisansüstü Uzmanlık Alan Dersi I	TB10[40]

Cumartesi

Saat	Ders Kodu	Ders Adı	Derslik
10:15-11:00	SEM7701(Z-2924)	SEMİNER	TB10[40]

Ofis Danışmanlık Saatleri

Gün	Başlangıç Saati	Bitiş Saati	Açıklamalar
Pazartesi	08:00	17:00	

Not: Uygulama saatleri yeşil renkle gösterilir

(E-Devlet ile giriş yapıldı)

AKADEMİK PERFORMANS DEĞERLENDİRME RAPORU

Yıl:	2025
Akademisyen Adı Soyadı:	ADEM EROL
Birim:	Ziraat Fakültesi Dekanlığı
Bölüm:	Tarla Bitkileri Bölüm Başkanlığı
Kategori:	Toplantı ve Eğitim
Faaliyet:	Genel Eğitim
Kapsam:	Yembitkilerinin Eroyon kontrolunda kullanılma olanakları
Başlangıç Tarihi:	01.09.2025
Bitiş Tarihi:	15.01.2026
Performans:	Lisansüstü ders verme
Puan:	5,00
Kanıt Dosya Sayısı:	1

2025 GÜZ VERİLEN DERSLER.html

Dosya C:/Users/User/Desktop/2025%20GÜZ%20VERİLEN%20DERSLER.html

Oturum aç · Sohbet et

Kahramanmaraş Sütçü İmam Üniversite

Akademik Bilgi Sistemi

- Ders İşlemleri
  - Kullanım Kılavuzu
  - Akademik Takvim
  - Verilen Dersler
  - Mobil Yoklama İşlemleri
  - Derslik Ders Programı
  - Ders Programı
  - Tıp Fakültesi Ders Programı
  - Değerlendirme Form Sonuçları
  - Ders Bilgi Paketi Tanımları
  - Araştırma Konuları
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- Akademik CV
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- Başvuru İşlemleri
- Kullanıcı İşlemleri

2025-2026 Güz

Doç.Dr. ADEM EROL

Öğretim Elemanı Ders Programı

Doç.Dr. ADEM EROL

Dönem 2025-2026 Güz

Yazdır

Pazartesi

Saat	Ders Kodu	Ders Adı	Derslik
13:00-13:45	BZF105(1)	BOTANİK I	ZF-D2-ED-Z-2[50]
14:00-14:45	BZF105(1)	BOTANİK I	ZF-D2-ED-Z-2[50]
15:00-15:45	BZF105(1)	BOTANİK I	ZF-D2-ED-Z-2[50]
16:00-16:45	BZF105(1)	BOTANİK I	ZF-D2-ED-Z-2[50]

Salı

Saat	Ders Kodu	Ders Adı	Derslik
09:15-10:00	TBZ5001(1)	YEM BİTKİLERİNDE KALİTE VE KALİTEYİ ETKİLEYEN FAK	TB10[40]
10:15-11:00	TBZ5001(1)	YEM BİTKİLERİNDE KALİTE VE KALİTEYİ ETKİLEYEN FAK	TB10[40]
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17:00-17:45	BTB411(1)	MEZUNİYET ÇALIŞMASI I	ZF-D2-ED-K2-8[57]
18:00-18:45	BTB411(1)	MEZUNİYET ÇALIŞMASI I	ZF-D2-ED-K2-8[57]

Çarşamba

Tanımlı Ders Programı Bulunamadı!

Perşembe

Saat	Ders Kodu	Ders Adı	Derslik
13:00-13:45	BTB303(1)	YEM BİTKİLERİ	ZF-D1-ED-K2-4[50]
14:00-14:45	BTB303(1)	YEM BİTKİLERİ	ZF-D1-ED-K2-4[50]
15:00-15:45	BTB303(1)	YEM BİTKİLERİ	ZF-D1-ED-K2-4[50]
16:00-16:45	BTB303(1)	YEM BİTKİLERİ	ZF-D1-ED-K2-4[50]

Cuma

Saat	Ders Kodu	Ders Adı	Derslik
08:15-09:00	UAD9001(Z-2924)	Lisansüstü Uzmanlık Alan Dersi I	TB10[40]
09:15-10:00	UAD9001(Z-2924)	Lisansüstü Uzmanlık Alan Dersi I	TB10[40]
10:15-11:00	UAD9001(Z-2924)	Lisansüstü Uzmanlık Alan Dersi I	TB10[40]
11:15-12:00	UAD9001(Z-2924)	Lisansüstü Uzmanlık Alan Dersi I	TB10[40]
13:00-13:45	UAD9001(Z-2924)	Lisansüstü Uzmanlık Alan Dersi I	TB10[40]
14:00-14:45	UAD9001(Z-2924)	Lisansüstü Uzmanlık Alan Dersi I	TB10[40]
15:00-15:45	UAD9001(Z-2924)	Lisansüstü Uzmanlık Alan Dersi I	TB10[40]
16:00-16:45	UAD9001(Z-2924)	Lisansüstü Uzmanlık Alan Dersi I	TB10[40]

Cumartesi

Saat	Ders Kodu	Ders Adı	Derslik
10:15-11:00	SEM7701(Z-2924)	SEMİNER	TB10[40]

Ofis Danışmanlık Saatleri

Gün	Başlangıç Saati	Bitiş Saati	Açıklamalar
Pazartesi	08:00	17:00	

Not: Uygulama saatleri yeşil renkle gösterilir

(E-Devlet ile giriş yapıldı)

12:27
6.12.2025

AKADEMİK PERFORMANS DEĞERLENDİRME RAPORU

Yıl:	2025
Akademisyen Adı Soyadı:	ADEM EROL
Birim:	Ziraat Fakültesi Dekanlığı
Bölüm:	Tarla Bitkileri Bölüm Başkanlığı
Kategori:	Diğer
Faaliyet:	Hakemlik
Kapsam:	Dergi yayın incelme
Başlangıç Tarihi:	01.01.2025
Bitiş Tarihi:	31.12.2025
Performans:	Dergi Hakemliği (Ulusal)
Puan:	5,00
Kanıt Dosya Sayısı:	1

Hakem **Bilim Kurulu** **Komisyon Üyesi** **Alt Komisyon Üyesi**

Değerlendirilecek Projeler(0) **Değerlendirilen Projeler(18)**

Proje	Proje Yürütücüsü	Atanma	Durum	Değerlendirmeyi Kabul/Re
KAHRAMANMARAŞ ŞARTLARINDA FARKLI ORGANOMİNERAL GÜBRE UYGULAMALARININ İSKENDERİYE ÜÇGÜLÜ (Trifolium Alexandrinum L.) TRİTİKALE (xTriticosecale Wittm.) KARIŞIMINDA KABA YEM VERİMİ VE SİLAJ KALİTESİ ÜZERİNE ETKİLERİNİN BELİRLENMESİ Proje Geneli	Ömer Süha USLU	23-09-2025	Değerlendirdi	Degerlendirme Talebi Kabul edilmiştir..
Farklı Ön Uygulamaların (Priming) Kocadarı (Sorghum vulgare L) Tohumundaki İlk Gelişme Dönemine Etkileri Proje Geneli	Leyla İDİKUT	08-08-2023	Değerlendirdi	Degerlendirme Talebi Kabul edilmiştir..
Yeni Geliştirilmiş Bazı Pamuk (Gossypium hirsutum L.) Çeşitlerinin Gaziantep Oğuzeli Şartlarında Verim, Verim Unsurları, Lif ve Yağ Kalite Özelliklerinin Belirlenmesi Proje Geneli	Ali Rahmi KAYA	14-06-2023	Değerlendirdi	Degerlendirme Talebi Kabul edilmiştir..
Bezelyenin Verim ve Kalite Kriterlerine Farklı Ekim Zamanlarının	Leyla İDİKUT	02-05-2023	Değerlendirdi	Degerlendirme Talebi Kabul edilmiştir..

Etkisinin Araştırılması Proje Geneli				
Bazı Silajlık Mısır Çeşitlerinin Bitki Fraksiyonlarında Epifitik Mikroorganizma Florası Dinamiğinin, Silaj Fermentasyon Profili ve Aerobik Stabilite Üzerine Etkileri Proje Geneli	Mustafa KIZILŞİMŞEK	13-04-2023	Değerlendirdi	Degerlendirme Talebi Kabul edilmiştir..
KAHRAMANMARAŞ ŞARTLARINDA YEM BEZELYESİ İLE (Pisum arvense L.) TRİTİKALE (xTriticosecale Wittm.) KARIŞIMLARININ SİLAJ KALİTESİNİN BELİRLENMESİ ÜZERİNE BİR ARAŞTIRMA (Bu araştırma projesi Kahramanmaraş ile ilgili öncelikli araştırma konuları arasında yer alan Madde 186. Mera ıslahı ve yem bitkileri konularında bilimsel çalışmaların artırılması " kapsamındadır.) Proje Geneli	Ömer Süha USLU	14-12-2022	Değerlendirdi	Degerlendirme Talebi Kabul edilmiştir..
Tarla Bitkileri Bölümü Çayır Mera ve Yem Bitkileri Laboratuvarı Altyapı Projesi Proje Geneli	Mustafa KIZILŞİMŞEK	19-08-2022	Değerlendirdi	Degerlendirme Talebi Kabul edilmiştir..
Laktik Asit Bakteri İnokulasyonu Uygulanan Kuşkonmaz Bitkisinden Silo Yemi Olarak Yararlanma Olanakları Proje Geneli	Mustafa KIZILŞİMŞEK	01-02-2021	Değerlendirdi	Degerlendirme Talebi Kabul edilmiştir..

KAHRAMANMARAŞ ŞARTLARINDA YULAF (Avena sativa L.) VE YEMLİK BEZELYE (Pisum sativum L.) KARIŞIK EKİM ORANLARININ OT VERİMİ VE KALİTESİ ÜZERİNE ETKİLERİNİN BELİRLENMESİ Proje Geneli	Ömer Süha USLU	17-04-2020	Değerlendirdi	Degerlendirme Talebi Kabul edilmiştir..
Sektörde Kullanılan Ambalajlama Yöntemleri ile 3D Cihazla Üretilecek Ambalajların İstifleme ve Muhafaza Performansının Gıda Ürünleri Üzerinde Karşılaştırılması Yeni proje başvurusu	İbrahim Sarper KARAKADILAR	16-10-2017	Değerlendirdi	Degerlendirme Talebi Kabul edilmiştir..
Kahramanmaraş Kuru Şartlarında Bazı Arpa Çeşitlerinin Verim, Verim Unsurları ve Kalite Özellikleri Üzerine Bir Araştırma Proje Geneli	Cengiz YÜRÜRDURMAZ	10-02-2017	Değerlendirdi	Degerlendirme Talebi Kabul edilmiştir..
KAHRAMANMARAŞ ŞARTLARINDA BAZI İTALYAN ÇİMİ (Lolium multiflorum Lam.) ÇEŞİTLERİNİN BİTKİSEL ÖZELLİKLERİ VE YEM DEĞERLERİ Proje Geneli	Ömer Süha USLU	08-02-2017	Değerlendirdi	Degerlendirme Talebi Kabul edilmiştir..
Kahramanmaraş Koşullarında Fiğ--Tritikale Karışım Yetiştirme Olanakları. Proje Geneli	Mustafa KIZILŞİMŞEK	08-02-2017	Değerlendirdi	Degerlendirme Talebi Kabul edilmiştir..
Kahramanmaraş İli Türkoğlu İlçesi Kuyumcular Merasında Farklı Azot Dozlarının	Ömer Süha USLU	08-02-2017	Değerlendirdi	Degerlendirme Talebi Kabul edilmiştir..

Meranın Verim ve Ot Kalitesi Üzerine Etkileri Proje Geneli				
Hasat zamanının katran yoncasının (Bituminaria bituminosa) kompozisyonuna, in vitro gaz üretimine ve metan üretimine etkisi Proje Geneli	Adem KAMALAK	05-10-2016	Değerlendirdi	Degerlendirme Talebi Kabul edilmiştir..
Farklı Zaman ve Farklı Miktarlarda Gidya Uygulamalarının Kahramanmaraş Türkoğlu İlçesi Kuyumcular Merasında Botanik Kompozisyon ve Verim Üzerine Etkileri Proje Geneli	Ömer Süha USLU	05-10-2016	Değerlendirdi	Degerlendirme Talebi Kabul edilmiştir..
Mekaniksel olarak farklı işlenmiş buğdaygil dane yemlerinin (arpa, buğday, çavdar, yulaf) ruminal in vitro sindirim potansiyellerinin belirlenmesi Proje Geneli	Mehmet Ali BAL	29-02-2016	Değerlendirdi	Degerlendirme Talebi Kabul edilmiştir..
Daha önceden izole edilmiş ve seçilmiş laktik asit bakterileri inokulantlarının yonca silajının kalitesi üzerine etkileri. Proje Geneli	Mustafa KIZILŞİMŞEK	11-11-2014	Değerlendirdi	Degerlendirme Talebi Kabul edilmiştir..

ÖNEMLİ NOTLAR:

- Atanmış bir projeyi değerlendirmeden önce projeyi **değerlendirmeyi kabul etmeniz gerekmektedir**.
- Lütfen değerlendirmek için vakit ayıramayacağınız projeleri kabul etmeyiniz. Ret ederek vakit kaybına engel olunuz.
- Değerlendirmek için kabul ettiğiniz projeleri en kısa zamanda değerlendirmeniz projenin gelişiminde vakit kaybını engelleyecektir.

TalentSoft Yazılım: e-BAP Otomasyonu

AKADEMİK PERFORMANS DEĞERLENDİRME RAPORU

Yıl:	2025
Akademisyen Adı Soyadı:	ADEM EROL
Birim:	Ziraat Fakültesi Dekanlığı
Bölüm:	Tarla Bitkileri Bölüm Başkanlığı
Kategori:	Bilimsel Etkinlik Katılımı
Faaliyet:	Kongre
Kapsam:	Avşar kampusunden toplanan yabani koca fiğ tohumlarında farlı prming uygulamalarının çimlenme oranı üzerine etkileri
Başlangıç Tarihi:	18.09.2025
Bitiş Tarihi:	22.09.2025
Performans:	Uluslararası bilimsel toplantılarda sunulan, özeti matbu veya elektronik olarak bildiri kitapçığında basılan sözlü bildiri
Puan:	10,00
Kanıt Dosya Sayısı:	1

T.C.
KAHRAMANMARAŞ SÜTÇÜ İMAM ÜNİVERSİTESİ
Bilimsel Araştırma Projeleri Koordinasyon Birimi

UKSP – BEP Projeleri Sonuç Detay Raporu

Dikkat! Sonuç raporunu göndermeden önce UKSP projesinde yolluk ödemesi alma, BEP projesinde ise satınalma işlemlerinizi tamamlayınız. Yolluk ödeme ve satınalma işlemleri duyuruları için KSÜ BAP sayfamızı ziyaret ediniz.

1.Projenin Adı: Bazı Tek Yıllık Baklagil Yem Bitkileri Tohumlarına Farklı Priming Uygulamaları ile Çimlenme Özelliklerinin Saptanması
2.Bilimsel Etkinliğin Adı: 8th International Agriculture Congress (UTAK-2025)
4. Bilimsel Etkinliğin Tarihi ve Yeri: 18 - 22 Eylül 2025 Semerkand/Özbekistan

Projenin Katılımcıya ve Kuruma Katkısını ve Sonuçlarını Yazınız.

1- **Katılımcıya Katkısı:** Bu bildiriyi sözlü olarak anılan kongrede oturum Salon 2'de düzenlenen oturumda saat 15:00-15:10 arasında sunulmuştur. Sunun sonucunda çalışma ile ilgili tartışma yapılmıştır. Bu projede Bazı Tek Yıllık Baklagil Yem Bitkileri Tohumlarına Farklı Priming Uygulamaları ile Çimlenme Özelliklerinin Saptanması' konusunda çimlenmede ön priming uygulamaları tartışılmıştır.. Ayrıca yurt dışında bu projenin sunulması sonucu, deneyim kazanılmıştır. Diğer oturumlarda sunulan bildiriler dinlenerek kendi alanımdaki gelişmeler hakkında bilgi sahibi edinilmiştir. Bunlara ek olarak alınımdaki bilim insanları ile bilgi alış verişinde bulunulmuştur.
   Özbekistan'ın Semarkand ve Buhara illerine gezi düzenlenmiş, şehrin tarihi kültürü, sosyal yapısı hakkında bilgiler edinilmiştir. Sonuç olarak bu proje kendime, hem bilimsel hem de kültürel, tarihi ve sosyal alanda katkılar sağlamıştır.

2- Kuruma Katkısı: 8th International Agriculture Congress (UTAK-2025), Özbekistan/ Semerkand'ta Anadolu Ziraat Mühendisleri Derneği öncülüğünde ve Samarkand Devlet Üniversitesi'nin ev sahipliğinde, Kahramanmaraş Sütçü İmam Üniversitesi, Urganch Devlet Üniversitesi, Giresun Üniversitesi, Iğdır Üniversitesi ve Nahçıvan Devlet Üniversitesi işbirliği ile 18-22 Eylül 2025'de gerçekleştirildi.
   Yapmış olduğumuz çalışmalar sonucunda elde ettiğimiz bilgi ve becerileri, üniversitemiz adına kardeş ve dost ülke olan Özbekistan'ın bilim insanı, araştırmacı ve üreticileri ile paylaşılmıştır. Diğer yandan Özbekistan'da kongreye katılmakla Özbekistan'daki kardeş halkla ile gönül bağı güçlendirilmiş ve var olan kültür birliğimiz tazelenmiştir. Bu şekilde üniversitemiz tanıtılmıştır.

3- Proje Sonuçları: Bu projenin 8th International Agriculture Congress (UTAK-2025) kapsamında, Özbekistan/Semerkand'ta bildirinin sunulması hem ülkemizin ve hem de üniversitemizin tanıtılmasına katkı sağlamıştır.. Bu sunulardan ortak araştırma yapmanın alt yapısı oluşturulmaya çalışılmıştır.

Not: Proje çalışmasının bilimsel yayına dönüşmesi halinde tam metninin BAP Otomasyonda ilgili projenin "Proje Yayını" kısmına yüklenerek BAP Koordinatörlüğüne EBYS'den gönderilmesi gerekmektedir.