Black Sea Journal of Agriculture
doi: 10.47115/bsagriculture.1616876

Open Access Journal
e-ISSN: 2618 – 6578

Research Article
Volume 8 - Issue 2 : 234-239 / March 2025

ASSESSMENT OF PASTURE NUTRITIONAL VALUE AND YIELD ON GİTO PLATEAU (ÇAMLIHEMŞİN, TÜRKİYE)

Muhammed İkbal ÇATAL[1]*

[1]*Recep Tayyip Erdoğan University, Faculty of Agriculture, Department of Field Crops, 53300, Rize, Türkiye.*

Abstract: This study investigated the nutritional value and yield of Gito Plateau pasture, located in the Çamlıhemşin district of Rize province, Türkiye, during the summers of 2023 and 2024. Plant samples from 12 different locations were collected and analyzed to determine their nutrient composition. The average dry matter yield was 114.12 kg/da. Crude protein content averaged 10.46%, with minimal inter-annual variation. Fiber analysis revealed average acid detergent fiber (ADF) and neutral detergent fiber (NDF) values of 37.44% and 69.10%, respectively, indicating moderate digestibility. Calculated feed quality parameters included digestible dry matter (DDM) of 59.73% and relative feed value (RFV) of 80.42. Mineral analysis showed average concentrations of phosphorus (0.24%), potassium (1.53%), calcium (1.13%), and magnesium (0.30%), with Ca/P and K/(Ca+Mg) ratios averaging 4.81 and 1.07, respectively. The relatively consistent nutrient composition across the two years suggests a stable forage resource. These findings provide baseline data on Gito Plateau's pasture nutritional value, informing sustainable grazing management practices and optimizing livestock production in the Eastern Black Sea Region of Türkiye. Further research is recommended to assess seasonal variations and the impact of grazing management on pasture quality.

Keywords: Gito Plateau, Rize, Forage quality, Nutrient composition

***Corresponding author:** Recep Tayyip Erdoğan University, Faculty of Agriculture, Department of Field Crops, 53300, Rize, Türkiye
E mail: muhammed.catal@erdogan.edu.tr (M.İ. ÇATAL)
Muhammed İkbal ÇATAL https://orcid.org/0000-0002-4888-770X

Received: January 09, 2025
Accepted: March 02, 2025
Published: March 15, 2025

Cite as: Çatal Mİ. 2025. Assessment of pasture nutritional value and yield on Gito Plateau (Çamlıhemşin, Türkiye). BSJ Agri, 8(2): 234-239.

1. Introduction

Feed costs represent a substantial expenditure in livestock production, making efficient feed utilization crucial. Pastures serve as the most economical source of roughage, underpinning sustainable livestock farming practices. Globally, approximately 70% of roughage consumed by livestock is derived from pastures (Lund, 2007). The increasing global population, coupled with the exacerbating effects of climate change and economic volatility, places increasing pressure on these ecosystems to provide high-quality roughage. However, the conversion of pasturelands to other land uses and the pervasive issue of overgrazing significantly threaten the productivity of these vital natural resources. Overgrazing is a primary driver of pasture degradation, particularly in arid and semi-arid regions (Snyman, 2005; Holechek et al., 2011). This degradation manifests in reduced pasture yields, deterioration of soil physical and chemical properties (Beukes and Cowling, 2003), and increased susceptibility to erosion. Moreover, overgrazing can facilitate the proliferation of undesirable plant species, reduce plant cover, and result in substantial biomass losses (Tongway et al., 2003; Çomaklı et al., 2012).

Both the quantity and quality of roughage obtained from pastures are critical factors for successful livestock operations (Heitschmidt et al., 1995). Consequently, sustainable pasture management necessitates practices aligned with sound ecological principles. Protecting existing pasture ecosystems and implementing effective rehabilitation strategies in degraded areas are of paramount importance. Achieving these goals requires a thorough assessment of current pasture conditions and the factors contributing to their decline. Effective rehabilitation strategies cannot be developed or implemented without a comprehensive understanding of the pasture vegetation. Therefore, prior to initiating any rehabilitation efforts, it is crucial to determine the botanical composition, yield, and quality characteristics of different pasture sections, especially those exhibiting variations in soil properties, topography, and plant cover. These data provide the foundation for implementing tailored rehabilitation practices (Çınar et al., 2014; Alay et al., 2016).

The nutritional value of feed derived from pastures and cultivated forage crops is directly linked to forage quality. A multitude of factors influence forage quality, including palatability, animal intake, digestibility, the presence of antinutritional compounds (such as toxins), chemical and morphological structure, and energy and protein content. Furthermore, environmental variables, such as climatic conditions (temperature and precipitation), seasonal variations, the relative proportions of grasses and legumes in the vegetation, altitude, and aspect, can significantly impact the quality of the resulting forage

(Kirilov, 2001; Kaya, 2008).

Several studies have investigated the factors influencing pasture yield and quality. Öner (2016) observed significantly higher dry matter yields (134.83 kg/da vs. 68.21 kg/da) and crude protein content (12.89% vs. 11.59%) in ungrazed areas compared to grazed areas within the Palandöken pastures of Erzurum, Türkiye, at an altitude of 2400 m. Conversely, ungrazed plots exhibited lower Neutral Detergent Fiber (NDF, 56.01-57.04%) and Acid Detergent Fiber (ADF, 36.53-39.90%) values. Slope also plays a crucial role, as demonstrated by Sürmen and Kara (2018) in Aydın province, Türkiye. Their analysis across five slopes (2%, 8%, 15%, 25%, and 30%) revealed dry matter yields ranging from 114.54 kg/da to 223.03 kg/da, with the 8% slope yielding the highest. The 8% slope also corresponded to the highest crude protein content (10.64%), while the 2% slope showed the highest Relative Feed Value (RFV, 101.35) and the lowest NDF content. Similarly, Severoğlu (2018) highlighted the negative correlation between slope and forage quality, reporting a dry matter yield of 56.43 kg/da, crude protein content of 8.14%, ADF content of 45.11%, and NDF content of 64.30%, with a botanical composition of 32.12% grasses, 25.28% legumes, and 42.60% other plant families.

This research investigates the livestock carrying capacity of Gito Plateau, located in the Çamlıhemşin district of Rize province within the Eastern Black Sea Region of Türkiye, through an examination of the nutritive value and mineral content of its plant species. Precise determination of plant composition and nutrient profiles is vital for the sustainable use of pasturelands and effective animal feeding. This study was conduct comprehensive nutrient and mineral analyses on plant samples, contributing valuable data to the development of effective pasture management practices for Gito Plateau.

2. Materials and Methods

2.1. Study Area

This study was conducted on Gito Plateau (Çamlıhemşin district, Rize province, Türkiye; 40° 54' 12'' N, 40° 54' 34'' E), a region known for its natural beauty in the Eastern Black Sea Region. Located approximately 2070 meters above sea level and 32 km from the district center, data were collected during 2023 and 2024. The study area's location and representative photographs are shown in figures 1 and 2, respectively. Gito Plateau is representative of the region's characteristic pasture ecosystems.

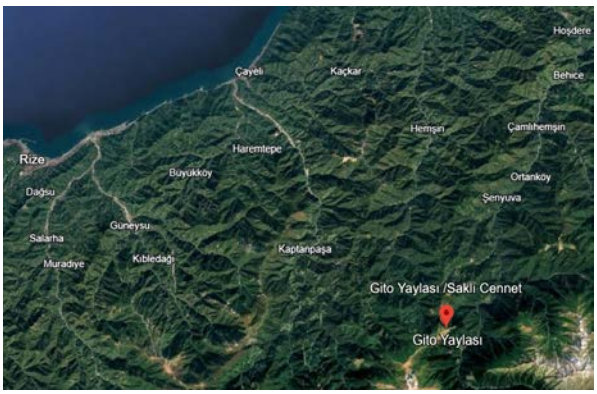

Figure 1. Location of the study area on the map (Google Earth).

Figure 2. Some photos taken from the study area (Date: July 22, 2023).

Soil samples collected from the study area underwent analysis to determine key physicochemical properties. The results revealed a clay-loam, texture with a saturation percentage of 74.8%, indicating a moderate water-holding capacity. The soil exhibited a strongly acidic reaction with a pH of 4.39. The total salt content was low (0.21%), categorized as slightly saline (low salinity), and the lime content was also low (0.11%), classified as slightly calcareous (low lime). The organic matter content was found to be moderate (2.01%). Available phosphorus (P_2O_5) and potassium (K_2O) levels were also moderate, measuring 5.29 kg/da and 38.16 kg/da, respectively. These findings suggest that the soil has a clay-loam texture, is strongly acidic, and has moderate levels of organic matter, phosphorus, and potassium, while salt and lime content are low. When the long-term meteorological data in Table 1 are analyzed, it is seen that Rize province has an average annual temperature of 14.5 °C and annual precipitation accumulation of 2301.2 mm (Anonymous, 2025).

Table 1. Long-term climate data of Rize province (Anonymous, 2025)

Rize (1928 – 2024)	Average Temperature (°C)	Average Highest Temperature (°C)	Average Lowest Temperature (°C)	Number of Rainy Days	Average Monthly Total Precipitation (mm)
January	6.9	10.7	3.9	14.69	231.9
February	6.8	10.8	3.7	14.25	185.2
Mart	8.1	12.0	4.9	15.80	161.3
April	11.7	15.5	8.4	14.48	95.2
May	16.0	19.4	12.7	14.31	96.6
June	20.4	23.6	16.8	14.13	134.1
July	22.9	26.0	19.7	13.68	151.0
August	23.3	26.6	20.1	14.18	195.3
September	20.3	24.1	17.0	14.64	257.5
October	16.4	20.5	13.1	14.85	296.3
November	12.3	16.5	9.1	13.57	255.3
December	8.9	12.9	5.8	14,11	241.5
Annual	14.5	18.2	11.3	172.7	2301.2

2.2. Methodology

Plant samples were collected from 12 distinct, different locations within the Gito Plateau study area during July of both 2023 and 2024. Vegetation was harvested at ground level using 50x50 cm quadrats (Türk and Özen, 2016). Fresh weights of the collected samples were measured *in situ* using a portable precision balance. Subsequently, samples were oven-dried at 70 °C for 48 hours to determine dry weights, which were then converted to yield per unit area (kg/da). The dried plant material was ground and homogenized using a mill equipped with a 1 mm sieve. The concentrations of crude protein (CP), acid detergent fiber (ADF), neutral detergent fiber (NDF), acid detergent protein (ADP), phosphorus (P), potassium (K), calcium (Ca), and magnesium (Mg) were determined using a Foss NIR Systems Model 6500 Win ISI II v1.5 NIRS instrument (Çaçan et al., 2014). Dry matter intake (DMI), digestible dry matter (DDM), relative feed value (RFV), digestible energy (DE), and metabolic energy (ME) were calculated from ADF and NDF values according to established equations from the literature: Digestible Dry Matter (DDM) = 88.9 - (0.779 x %ADF) (Oddy et al., 1983); Dry Matter Intake (DMI) = 120 / (%NDF) (Sheaffer et al., 1995); Relative Feed Value (RFV) = (DDM x DMI) / 1.29 (Sheaffer et al., 1995); Digestible Energy (DE) = 0.27 + 0.0428 x (%DDM) (Fonnesbeck et al., 1984); Metabolizable Energy (ME) = 0.821 x DE (Mcal/kg) (Khalil et al., 1986). Finally, Ca/P and K/(Ca+Mg) ratios were calculated to assess the interrelationships among macro element concentrations.

2.3. Statistical Analysis

Descriptive statistics were employed to analyze the data collected for the parameters examined in this study. Data were processed using the JMP statistical software package to calculate descriptive measures. These measures included means, standard deviations, and ranges for each parameter.

3. Results

The nutrient composition of grass samples collected from Gito Plateau over a two-year period is summarized in Table 2. These data provide valuable insights into the overall nutritional quality of the pasture and potential variations in nutrient content between years.

Table 2 presents the yield and nutrient composition data obtained from the two-year analysis of grass samples collected from Gito Plateau. The average fresh yield (FY) was 480 kg/da, with values of 496±36.25 kg/da in the first year and 465±24.04 kg/da in the second year, demonstrating a slight inter-annual variation. Dry matter yield (DY) averaged 114 kg/da, with respective values of 120±7.34 kg/da and 108±7.05 kg/da for the first and second years. Crude protein (CP) content remained relatively consistent across both years, averaging 10.46%, with values of 10.48±1.83% and 10.43±1.44%.

Acid detergent fiber (ADF) content averaged 37.44%, with values of 37.60±4.02% and 37.28±2.86% for the first and second years, respectively. Neutral detergent fiber (NDF) averaged 69.10%, with values of 68.77±3.59% and 69.43±5.64% observed in the first and second years. Acid detergent protein (ADP) levels were very similar across both years, averaging 1.15%. Digestible dry matter (DDM) averaged 59.73%, with values of 59.61±2.23% and 59.86±3.13% for the two years. Dry matter intake (DMI) averaged 1.74%, showing minimal variation between years (1.74±0.15% and 1.73±0.09%). Relative feed value (RFV) averaged 80.42, with values of 80.63±11.53% and 80.20±9.38% for the first and second years. Digestible energy (DE) averaged 2.83 Mcal/kg, with values of 2.82±0.13 and 2.83±0.10 Mcal/kg. Metabolizable energy (ME) also showed little variation, averaging 2.32 Mcal/kg. Regarding mineral content, phosphorus (P) averaged 0.24%, potassium (K) averaged 1.53%, calcium (Ca) averaged 1.13%, and magnesium (Mg) averaged 0.30%. The Ca/P ratio averaged 4.81, with values of 4.96±1.74 and 4.67±1.71 for the two years. The K/(Ca+Mg) ratio averaged 1.07, with minimal variation between years (1.07±0.13 and 1.08±0.10). Overall, the nutrient composition of Gito Plateau pasture exhibited relatively small variations between the two years of the study, indicating a consistent nutritional profile.

Table 2. Yield and nutritional value of Gito Plateau pasture

Features Analyzed	1.Year	2.Year	Average
Fresh Yield (FY) (kg/da)	496±36.25	465±24.04	480
Dry Matter Yield (DY) (kg/da)	120±7.34	108±7.05	114
Crude Protein (CP) (%)	10.48±1.83	10.43±1.44	10.46
Acid Detergent Fiber (ADF) (%)	37.60±4.02	37.28±2.86	37.44
Neutral Detergent Fiber (NDF) (%)	68.77±3.59	69.43±5.64	69.10
Acid Detergent Protein (ADP) (%)	1.15±0.06	1.14±0.12	1.15
Digestible Dry Matter (DDM)	59.61±2.23	59.86±3.13	59.73
Dry Matter Intake (DMI)	1.74±0.15	1.73±0.09	1.74
Relative Feed Value (RFV)	80.63±11.53	80.20±9.38	80.42
Digestible Energy (DE) (Mcal/kg)	2.82±0.13	2.83±0.10	2.83
Metabolic Energy (ME) (Mcal/kg)	2.32±0.08	2.33±0.11	2.32
Phosphorus (P) (%)	0.23±0.08	0.24±0.09	0.24
Potassium (K) (%)	1.54±0.31	1.52±0.25	1.53
Calcium (Ca) (%)	1.14±0.09	1.12±0.09	1.13
Magnesium (Mg) (%)	0.30±0.05	0.29±0.05	0.30
Ca/P	4.96±1.74	4.67±1.71	4.81
K/(Ca+Mg)	1.07±0.13	1.08±0.10	1.07

4. Discussion

The nutritional composition of Gito Plateau pasture, as presented in Table 2, reveals valuable insights into its forage quality. The average dry matter yield (114.12 kg/da) observed in this study is notably lower than the maximum dry matter yield (827.3 kg/da) reported by Kılıç (2018) for Beypınarı pasture in Trabzon. This difference could be attributed to variations in environmental factors such as altitude, precipitation, soil type, and grazing management practices between the two locations. Furthermore, the fact that the pasture area under study was accessible to grazing also contributed to the low yield. This is because continuous and uncontrolled grazing can negatively impact the growth and development of plants, reducing their photosynthetic capacity and consequently leading to a decrease in biomass and overall productivity. The crude protein (CP) content of Gito Plateau pasture (10.46%) is also lower than the values reported by Kılıç (2018) (16.6%), Şahinoğlu (2010) (16.33-18.64%), Nadir (2010) (16.48-18.81%), and Aydın and Başbağ (2017) (19.19%) for different regions in Türkiye. This difference in CP content may reflect differences in plant species composition, soil fertility, and fertilization practices.

Regarding fiber content, the average ADF (37.44%) and NDF (69.10%) values for Gito Plateau are comparable to the ranges reported by Tutar and Kökten (2019) for Bingöl (ADF: 34.8-37.4%; NDF: 52.5-62.7%) but generally higher than those reported by Şahinoğlu (2010) (ADF: %29.82-31.99; NDF: %46.39-55.21), Nadir (2010) (ADF: %24.38-26.84; NDF: %34.59-36.32), and Parlak et al. (2015) (ADF: %29.40-31.73; NDF: %43.18-51.57). Higher fiber content can indicate lower digestibility and energy content. The digestible dry matter (DDM) of Gito Plateau pasture (59.73%) is lower than the value reported by Kılıç (2018) (61.0%) and Aydın and Başbağ (2017) (65.70%), which aligns with the observed differences in fiber content. The relative feed value (RFV) of Gito Plateau (80.42) is considerably lower than the values reported by Nadir (2010) (174.96-189.77) and Aydın and Başbağ (2017) (137.7), further supporting the lower overall forage quality compared to these studies.

The mineral content of Gito Plateau pasture also shows some variations compared to other studies. Phosphorus

(P) content (0.24%) is lower than the ranges reported by Şahinoğlu (2010) (0.40-0.43%) and Aydın and Başbağ (2017) (0.34%). Potassium (K) content (1.53%) is also lower than the values reported by Şahinoğlu (2010) (2.32-2.60%) and Aydın and Başbağ (2017) (2.42%). Calcium (Ca) content (1.13%) is within the range reported by Şahinoğlu (2010) (0.90-1.33%) and similar to Aydın and Başbağ (2017) (1.09%). Magnesium (Mg) content (0.30%) is also within the range reported by Şahinoğlu (2010) (0.26-0.36%) and similar to Aydın and Başbağ (2017) (0.31%). The K/(Ca+Mg) ratio (1.07) is lower than the range reported by Şahinoğlu (2010) (1.61-2.13). These differences in mineral content can be attributed to variations in soil mineral composition and plant species.

In conclusion, the nutritional quality of Gito Plateau pasture, while providing adequate forage, appears to be generally lower in terms of dry matter yield, crude protein, and relative feed value compared to other pastures studied in different regions of Türkiye. These differences highlight the importance of site-specific management strategies tailored to the unique characteristics of each pasture ecosystem.

5. Conclusion

This study investigated the nutritional value of Gito Plateau pasture in the Çamlıhemşin district of Rize province, Türkiye, during the summers of 2023 and 2024. Analysis of plant samples collected from 12 distinct locations revealed valuable insights into the forage quality of this important pasture ecosystem. The average dry matter yield was found to be 114.12 kg/da, with relatively consistent crude protein content averaging 10.46% across both years. Fiber content, as indicated by ADF (37.44%) and NDF (69.10%), suggests a moderate level of digestibility. Calculated feed quality parameters, including DDM (59.73%) and RFV (80.42), further characterized the nutritional value of the pasture. Mineral analysis revealed average concentrations of phosphorus (0.24%), potassium (1.53%), calcium (1.13%), and magnesium (0.30%), with calculated Ca/P and K/(Ca+Mg) ratios averaging 4.81 and 1.07, respectively.

The relatively consistent nutrient composition observed over the two-year study period suggests a stable forage resource. However, further research is needed to investigate the seasonal variations in nutrient content and the influence of grazing management practices on pasture quality. This study provides baseline data on the nutritional value of Gito Plateau pasture, which can be used to inform sustainable grazing management strategies and optimize livestock production in the region. These findings contribute to a better understanding of the pasture's potential to support livestock and highlight the importance of continued monitoring and management of this valuable natural resource in Türkiye's Eastern Black Sea Region.

Author Contributions

The percentages of the author contributions are presented below. All authors reviewed and approved the final version of the manuscript.

	M.İ.Ç.
C	100
D	100
S	100
DCP	100
DAI	100
L	100
W	100
CR	100
SR	100
PM	100
FA	100

C= concept, D= design, S= supervision, DCP= data collection and/or processing, DAI= data analysis and/or interpretation, L= literature search, W= writing, CR= critical review, SR= submission and revision, PM= project management, FA= funding acquisition.

Conflict of Interest

The author declared that there is no conflict of interest.

Ethical Consideration

Ethics committee approval was not required for this study because there was no study on animals or humans.

References

Alay F, İspirli K, Uzun F, Çınar S, Aydın İ, Çankaya N. 2016. Uzun süreli serbest otlatmanın doğal meralar üzerine etkileri. Gaziosmanpaşa Üniv Zir Fak Derg, 33 (1): 116 124.

Anonymous. 2025. T.C. Prime Ministry General Directorate of State Meteorological Affairs, Rize provincial directorate records. URL: https://www.mgm.gov.tr/veridegerlendirme/il-ve-ilceler-istatistik.aspx?k=undefined&m=RIZE (Accessed Date: March 2, 2025).

Aydın A, Başbağ M. 2017. Karacadağ'ın farklı yükseltilerindeki meraların durumu ve ot kalitesinin belirlenmesi. Anadolu Tar Bil Derg, 32(1): 74-84.

Beukes P C, Cowling RM. 2003. Non-selective grazing impacts on soil properties of the Nama Karoo. J Range Manag, 56: 547-552.

Çaçan E, Aydın A, Başbağ M. 2014. Korunan ve otlatılan iki farklı doğal alanın verim ve kalite açısından karşılaştırılması. TURKJANS, 1(Özel Sayı-1): 919-926.

Çınar S, Hatipoğlu R, Avcı M, İnal İ, Yücel C, Avağ A. 2014. Hatay ili Kırıkhan ilçesi taban meralarının vejetasyon yapısı üzerine bir araştırma. Gaziosmanpaşa Üniv Zir Fak Derg, 31(2): 52-60.

Çomaklı B, Fayetörbay D, Daşcı M. 2012. Changing of botanical composition and canopy coverage ratio in rangelands at different altitudes. Res J Agric Sci, 43(1): 17-21.

Fonnesbeck PV, Clark DH, Garret WN, Speth CF. 1984. Predicting energy utilization from alfalfa hay from the Western Region. Proc of Am Soci Anim Sci (Western Section), 35: 305-308.

Heitschmidt RK, Grings EE, Haferkamp MR, Karl MG. 1995. Herbage dynamics on two northern Great Plains range sites.

J Range Manag, 48: 211-217.

Holechek JL, Pieper RD, Herbel CH. 2011. Range management principles and practices. Sixth edition. Prentice Hall, Upper Saddle River, New Jersey, USA, pp: 444.

Kaya Ş. 2008. Kaba yemlerin değerlendirilmesinde göreceli yem değeri ve göreceli kaba yem kalite indeksi. Türk Bil Der Derg, 1(1): 59 64.

Khalil JK, Sawaya WN, Hyder SZ. 1986. Nutrient composition of Atriplex leaves grown in Saudi Arabia. J Range Manag, 39: 104-107.

Kılıç S. 2018. Trabzon ili Düzköy ilçesi Beypınarı merasında farklı gübre uygulamalarının meranın verim, kalite ve botanik kompozisyonuna etkileri üzerine bir araştırma. Yüksek Lisans Tezi, Tokat Gaziosmanpaşa Üniversitesi, Tokat, Türkiye, pp: 47.

Kirilov A. 2001. Lucerne quality and possibilities for its estimation, In : I. Delgado and J. Lloveras (Eds.), Quality in lucerne and medics for animal production. Zaragoza, CIHEAM, pp: 231-234, http://om.ciheam.org/om/pdf/a45/01600089.pdf (accessed date: October 23, 2016).

Lund HG. 2007. Accounting for the world's rangelands. Rangelands, 29(1): 3-10.

Nadir M. 2010. Tokat ili Yeşilyurt köyü doğal merasının botanik kompozisyon, kuru madde verimi ve kalitesinin belirlenmesi. Yüksek Lisans, Gaziosmanpaşa Üniversitesi, Tokat, Türkiye, pp: 72.

Oddy VH, Robards GE, Low SG. 1983. Prediction of in vivo dry matter digestibility from the fiber nitrogen content of a feed. In: Feed Information and Animal Production. (ed) Robards GE, Packham, RG. Common wealth Agricultural Bureau, Farnham Royal, UK, 395-398.

Öner T. 2016. Yüksek rakımlı korunan ve otlatılan mera kesimlerinde bazı bitki örtüsü ile toprak özellikleri arasındaki ilişkiler. Doktora Tezi, Atatürk Üniversitesi, Fen Bilimleri Enstitüsü, Tarla Bitkileri Anabilim Dalı, Erzurum, Türkiye, pp: 65.

Parlak AÖ, Parlak M, Gökkuş A, Demiray HC. 2015. Akdeniz (Çanakkale) meralarının ot verimi ve kalitesi ile botanik kompozisyonu ve bazı toprak özellikleri. COMU J Agri Fac, 3(1): 99-108.

Severoğlu S. 2018. Eğime bağlı olarak mera bitki örtüsünün değişimi. Yüksek Lisans Tezi, Atatürk Üniversitesi Fen Bilimleri Enstitüsü Tarla Bitkileri Anabilim Dalı, Erzurum, Türkiye, pp: 57.

Sheaffer CC, Peterson MA, Mccalin M, Volene JJ, Cherney JH, Johnson KD, Woodward WT, Viands DR. 1995. Acid detergent fiber, neutral detergent fiber concentration and relative feed value. In: North American Alfalfa Improvement Conference, Standard Tests to Characterize Alfalfa Cultivars, 2-7 March, Minnesota, USA, URL: https://www.naaic.org/resource/stdtests.php (Accessed Date: March 2, 2025).

Snyman HA. 2005. Rangeland degradation in a semi-arid South Africa. I: influence on seasonal root distribution, root/shoot ratios, and water-use efficiency. J Arid Environ, 60: 457-481. https://doi.org/10.1016/j.jaridenv.2004.06.006

Sürmen M, Kara E, 2018. Aydın ili ekolojik koşullarında farklı eğimlerdeki mera vejetasyonlarının verim ve kalite özellikleri. Derim Derg, 35(1): 67-72.

Şahinoğlu O. 2010. Bafra ilçesi Koşu köyü merasında uygulanan farklı ıslah yöntemlerinin meranın ot verimi, yem kalitesi ve botanik kompozisyonu üzerine etkileri. Doktora Tezi, Ondokuz Mayıs Üniversitesi, Samsun, Türkiye, pp: 57.

Tongway DJ, Sparrow AD. Friedel MH. 2003. Degradation and recovery processes in arid grazing lands of central Australia. Part I: Soil and Land Resources. J Arid Environ, 55: 302-326.

Tutar H, Kökten K, 2019. Mera vejetasyon özelliklerinin farklı yöneylere göre değişimi. Türk Tar Araş Derg, 6(3): 312-318.

Türk M, Özen F. 2016. ağlasun orman içi meralarının verim ve kalitesinin belirlenmesi. Ziraat Fak Derg, 11(1): 82-88.