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Mixtures Created for Artificial Meadow-Pasture Areas According to the Animal Type to Graze and the Effect of Organic Fertilization on Botanical Composition

Rabiya KOYUNCU[1,*], Mehmet Ali AVCI[1]

[1]Selçuk University, Faculty of Agriculture, Department of Field Crops, Konya, Turkey

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ABSTRACT

This research was carried out in Selçuk University Abdülkadir Akçin application area. The aim of the study is to determine the effects of organic fertilization on botanical composition in plant mixtures created for artificial meadow-pasture areas created according to animal grazing habits. 3 different mixes for meadow and pasture; Ovine-poultry (*Lolium perenne, Festuca rubra, Poa pratensis, Trifolium repens*), cattle-1 (*Lolium perenne, Dactylis glomerata, Bromus inermis, Trifolium pratense, Medicago falcata*), cattle-2 (*Festuca arundinecea, Dactylis glomerata, Astragalus cicer, Trifolium pratense, Medicago falcata*) were prepared and 6 different fertilizers (cow-sheep-chicken-worm-chemical-without fertilizer) were applied for these mixtures. The botanical compositions of the mixtures were determined by frame method. Results indicated that the botanical composition of grasses was found the highest in the mixes prepared for ovine-poultry and sheep manure, while the ratio of legume plants was found the highest in the mixture prepared for cattle-2 and in the parcels where chicken manure was applied.

1. Introduction

Meadow and pasture areas are one of the most important natural resources of a country and have a large share in the supply roughage, which is the most important input in animal production (Tutar and Kökten 2019). It also provides benefits in preventing erosion, protecting water resources and biodiversity, maintaining the presence of medicinal plants and wild vegetables (Gökkuş and Koç 2001; Bilgili and Koç 2020). In Turkey, pastures have decreased steadily every year, from 44 million hectares to 14.6 million hectares for nearly six decades (Anonymous 2020). Also, vegetation-covered ratio and botanical composition have decreased in pastures due to the irregular and overgrazing at the same period. This pressure on the pastures and adverse competition conditions lead to the exixting of plants with high forage value and preferred by animals and an increase in invasive species, and also causes erosion risk in sloping areas (Gökkuş and Koç 2001; Palta and Lermi 2019). All these negativities limits the use of our pastureland puts our animal husbandry in an impasse (Gökkuş 2018). For this reason, artificial meadows and pastures are gaining importance in order to meet the feed needs of animals and these areas will become a necessity in the future. Formation of appropriate mixtures with the grasses and legumes that form the basis of the botanical compositions of artificial pastures is of great importance in the supply of feed. These mixtures created have many advantages (Sleugh et al 2000; Berdahl et al 2001; Koç et al 2004; Deak et al 2007). The grass obtained is richer in terms of protein and carbohydrate content, and also in terms of vitamins and minerals. Animals will be able to have a healthier and higher animal yield performance with a balanced diet in terms of nutrient content (Tan 2018). Again, created artificial meadows and pastures ensure that more feed products are taken from the unit area and as a result, animal products increase in the enterprise. Artificial meadow and pasture areas to be established will also reduce the burden of natural meadows and pastures to some extent (Atış and Hatipoğlu 2008). These areas need to be fertilized in order to maintain their continuity. Fertilization has been one of the main improving methods in the production of abundant and high quality feed in areas with sufficient rainfall and in irrigable pasture and highland areas (Büyükburç 1980; Tükel et al 1996; Reis 2002). Recently, many studies from almost all over the world have shown that fertilization has many positive effects on pasture vegetation (Rubıo et al 1996; Cosper et al 1967; Baker and Powel 1982; Yavuz 2007). Based on the positive results obtained from the research, applications in large areas have been started. However, more local studies are needed on the fertilization of our pastures (Bakır 1985;

* Corresponding author email: *rabia@koyuncu.com*

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Gedikli 2019). In studies conducted in our country and in different countries of the world, it has been determined that vegetation can benefit more effectively from rainfalls with fertilization, and increases the grass yield and quality of vegetation can be achieved (Tükel et al 1996). In addition to the increase in yield with fertilization, there are improvements in features such as botanical composition, feed chemical structure, green feed period and feed palatability (Uslu 2005). Fertilization is the application of plant nutrients needed by plants in different ways, in the form they need, at the right time and with the most accurate method (Altın and Gökkuş 2005). The intensive use of chemical fertilizers in meadow and pasture areas causes the soil to become inefficient over time and the ecology to deteriorate. For this reason, studies have been carried out within the scope of organic agriculture in today's agriculture understanding and environmentally friendly practices have started to be developed with this understanding. "Fertilizer and urine", which are animal wastes, gains importance as an organic material that is used for the purpose of increasing plant production and protecting the environment and is called organic fertilizer when used in certain measures in agricultural enterprises. It is thought that the correct use of these fertilizers will be a very smart investment for the sustainable environment and the future of organic agriculture. Considering the increasing importance of organic agriculture today and the increasing demand for organic products, the use of natural fertilizer resources is predicted in this study. In the 21st century, it is observed that people prefer products produced by organic methods instead of animal products produced by chemical methods. Animal products produced by this method, especially in developed countries, find a market with higher prices (Bayram 2005). When meat and dairy farming is carried out by applying organic agriculture in meadow-pasture areas, the product increase of the animals is maintained and the floristic composition of the pastures also improves. For this reason, organic practice in meadows and pastures has become widespread in central Europe in recent years, and very serious projects are being carried out between countries (Isselstein et al 2003; Briemle 2000).

One of the most important features of the study conducted in the light of all this information is to investigate the effect of organic fertilizers on the botanical composition in the artificial meadow-pasture areas created according to the eating habits of the animals. The fact that pastures are widespread in arid areas where agricultural activities are restricted (Holechek 2004), unfavorable conditions caused by drought and often not using pastures in accordance with management principles cause roughage deficits during the grazing season. Setting up artificial pastures is one of the ways to meet this feed deficit (Gökkuş 2014). In addition, drought-resistant plant species were selected in the artificial meadow-pasture mixes we created.

2. Materials and Methods

Field work related to this research was carried out in Selçuk University Faculty of Agriculture Abdülkadir Akçin Application Field. Three different mixtures were prepared to be used in meadow-pasture areas according to the animal type to be grazed. The reasons for choosing the plants used while creating the mixtures: *T.repens* is not oversized and has stolon structure (Geçit et al 2009), *L.perenne* has a high ability to withstand heavy grazing (Jung et al 1996), *F.rubra* and *P.pratensis* are rhizome and are fondly preferred by animals (Palta and Altıntaş 2018), *D.glomerata* is resistant to grazing and mowing and it starts to grow in early spring (Açıkgöz 2001; Can and Ayan 2017), the nutritional value of *A.cicer* is equivalent to alfalfa, its greenness is preserved until late autumn, it does not cause physiological problems for animals (Karakurt 2004), *M.falcata* has a horizontal form resistant to grazing and crushing, the quality and nutritional value of *T.pratense* grass is quite high (Avcıoğlu et al 2009), it is abundant productive and rapid development of *B.inermis* (Elçi 2005), wide adaptation ability of *F.arundinecea* and resistant to mowing – grazing (Manga et al 2002). The seeds were weighed by making appropriate calculations according to the weight of one thousand kernels and the result of the germination test made before. While creating the mixtures, the calculation was made by taking the percentage of the pure planting amount of the seeds. The amount of seeds used in the mixture are given in the Table 1, 2 and 3 for each mixture.

Table 1
Amounts of seeds used in the mixture for ovine-poultry

Ovine-Poultry				
Seed/presence rates in the mix	Seed amount to be thrown (kg da^{-1})	Pure sowing percentage (kg da^{-1})	Germination rate (%)	Seed amount thrown according to germination rate (kg da^{-1})
Lolium perenne (50%)	2.5	1.25	59.5	2.10
Festuca rubra (35%)	1	0.35	9.5	3.68
Poa pratensis (10%)	0.5	0.05	8.5	0.58
Trifolium repens (5%)	0.3	0.015	80.25	0.01

Table 2
Amounts of seeds used in the mixture for cattle-1

Cattle-1				
Seed/presence rates in the mix	Seed amount to be thrown (kg da^{-1})	Pure sowing percentage (kg da^{-1})	Germination rate (%)	Seed amount thrown according to germination rate (kg da^{-1})
Lolium perenne (40%)	2.5	1	59.5	1.68
D. glomerata (20%)	2.5	0.5	50	1.00
Bromus inermis (20%)	2.5	0.5	50	1.00
T. pratense (10%)	0.5	0.05	70.5	0.07
M. falcata (10%)	0.3	0.03	37.5	0.08

Table 3
Amounts of seeds used in the mix for cattle-2

Cattle-2				
Seed/presence rates in the mix	Seed amount to be thrown (kg da^{-1})	Pure sowing percentage (kg da^{-1})	Germination rate (%)	Seed amount thrown according to germination rate (kg da^{-1})
F. arundinecea (40%)	2	0.8	75.75	1.05
D.glomerata (20%)	2.5	0.5	50	1.00
A. cicer (20%)	0.5	0.1	54	0.18
T. pratanse (10%)	0.5	0.05	70.5	0.07
M. falcata (10%)	0.3	0.03	37.5	0.08

Organic fertilizers subject to the study; It is worm, cattle, chicken and sheep fertilizer. In addition, traditional method and fertilizer-free method were applied. The research was established on 22.07.2020 with 4 replications according to the divided plots trial pattern in random blocks. Fertilizers were added to the main parcels and mixtures were applied to the sub plots. Mixtures were planted on the sub plots 1m long and 1m wide. 6x3x4 = 72 sub plots were created. Plot spacing is 2.5m, sub plot spacing is 1m and between replications is 2.5m. The reason for applying organic fertilizer types to the main plots in the trial is to minimize the impact each other of the fertilizers and to prevent excessive growth of the trial area. The fertilizers subject to the study were applied to the soil in a single dose and before planting due to economic factors and ease of application and mixed with soil cultivation tools. The analysis of each fertilizer was made before planting and fertilizers were adjusted to be 8kg pure nitrogen (N_2) per decare. One month after planting, the botanical composition of the plants was determined by the frame method. For this, a frame made of wood with a size of 10x10 cm was used. Plants in 1 dm ^{2} with frame were counted as pieces. Each plot was counted 3 times and averaged.

3. Results and Discussion

In this study, the effects of mixtures prepared according to different animal preferences and the use of organic fertilizers on the botanical composition formed in meadow-pasture areas were observed. The botanical compositions of grasses and legumes were evaluated separately.

3.1. Grasses in Botanical Composition

The analysis of variance regarding the effect of organic fertilizer applications on different mixtures made in the artificially created meadow-pasture area on plants from the grasses family in botanical composition is given in Table 4.

Table 4
Analysis of Variance Regarding the Effect of Organic Fertilizer Applications on Different Mixtures Made in the Artificially Created Meadow-Pasture Area on Plants from the Grasses Family in Botanical Composition

Grasses (%)				
Source of variation	Degrees of freedom	Sum of squares	Mean squares	F value
Replication	3	1189,49	396,495	2.8311
Fertilizer	5	2559.07	511.814	3.6545*
Error 1	15	2100.76	140.051	
Mixture	2	5248.44	2624.22	55.4088**
Fertilizer x Mixture	10	1503.89	150.389	3.1754**
Error 2	36	1705.000	47.361	
General	71	14306,653		
CV: 28.8633				

*: $p < 0.05$; **: $p < 0.01$

According to Table 4, fertilizer applications were found to be 5% significant according to the variance analysis results of the percentages of grasses found in artificially created meadow-pasture. There were statistically significant differences at 1% level between mixture, fertilizer x mixture interactions. The average values and LSD groups found for grasses percentages for botanical composition are given in Table 5.

Table 5
Average values (%) and LSD groups belongs to the ratio of grasses plants in the botanical composition of artificially created meadow-pasture of organic fertilizer applications belonging to mixtures.

Mixture	Grasses (%)						
	Sheep	Cow	Chicken	Worm	Chemical	Without fertilizer	Average
Ovine-poultry	80.50A	52.75B-F	49.75C-H	64.00B	55.75B-E	58.00B-D	60.12A
Cattle-1	61.25BC	51.00B-G	38.75G-I	42.50F-I	48.25C-H	47.00D-I	48.12B
Cattle-2	41.50F-I	34.75I	37.00HI	44.50E-I	43.50E-I	34.50I	39.29C
Average	61.08a	46.16b	41.83b	50.33b	49.16b	46.50b	49.17

$LSD_{mixture}$ = 5.403; $LSD_{fertilizer}$= 10.30; $LSD_{fertilizer\ x\ mixture}$= 13.23

According to Table 5, sheep manure (61.08%) had the highest statistical effect on the ratio of cereal plants in botanical composition. This was followed by worm (50.33%), chemical (49.16%), without fertilizer (46.50%), cow (46.16%) and chicken manure (41.83%) in descending order. However, except sheep manure, other fertilizers are in the same group. The mixtures that make up the artificial meadow-pasture are divided into 3 groups and the mixture with the highest rate of wheat in the botanical composition is the mixture of ovine-poultry (*Lolium perenne, Festuca rubra, Poa pratensis*) with 60.12% ratio. This is followed by a mixture of cattle-1(*Lolium perenne, Dactylis glomerata, Bromus inermis*) with a ratio of 48.12% and a ratio of cattle-2 (*Festuca arundinecea, Dactylis glomerata*) with a ratio of 39.29% in descending order. When we look at the fertilizer x mixture intreactions, the highest value was found in the parcel where ovine-poultry mixture and sheep manure was applied with 80.50%. The lowest botanical composition ratio was obtained in cattle-2 mixture with 34.50% and the plot without fertilizer.

3.2. Legumes in Botanical Composition

The analysis of variance regarding the effect of organic fertilizer applications on different mixtures made in the artificially created meadow-pasture area on plants from the legumes family in botanical composition is given in Table 6.

Table 6
Analysis of Variance Regarding the Effect of Organic Fertilizer Applications on Different Mixtures Made in the Artificially Created Meadow-Pasture Area on Plants from the Legumes Family in Botanical Composition

	Legumes (%)			
Source of Variation	Degrees Of Freedom	Sum Of Squares	Mean Squares	F value
Replication	3	1191.61	397,204	2.8212
Fertilizer	5	2544.44	508.889	3.6145*
Error 1	15	2111.89	140.793	
Mixture	2	5270.36	2635.18	55.6402**
Fertilizer x Mixture	10	1497.97	149.797	3.1629**
Error 2	36	1705.000	47.361	
General	71	14321,278		
CV: 27.9544				

*: $p < 0.05$; **: $p < 0.01$

According to Table 6, fertilizer applications were found to be 5% significant according to the variance analysis results of the percentages of grasses found in artificially created meadow-pasture. There were statistically significant differences at 1% level between mixture, fertilizer x mixture interactions. The average values and LSD groups found for grasses percentages for botanical composition are given in Table 7.

Table 7
Average values (%) and LSD groups belongs to the ratio of legume plants in the botanical composition of artificially created meadow-pasture of organic fertilizer applications belonging to mixtures

Mixture	Legumes (%)						
	Sheep	Cow	Chicken	Worm	Chemical	Without fertilizer	Average
Ovine-poultry	19.50I	47.25D-H	50.00B-G	36.00H	44.25E-H	42.00F-H	39.83C
Cattle-1	38.75GH	49.00C-H	61.25A-C	57.50A-D	51.75B-G	53.00A-F	51.87B
Cattle-2	58.50A-D	65.25A	63.00AB	55.50A-E	56.50A-E	65.50A	60.70A
Average	38.91b	53.83a	58.08a	49.66a	50.83a	53.50a	50.80

$LSD_{mixture}$: 5.403; $LSD_{fertilizer}$: 10.32 $LSD_{fertilizer\ x\ mixture}$: 13.23

According to Table 7, chicken manure (58.08%) had the highest statistical effect on the ratio of cereal plants in botanical composition. This was followed by cow (53.83%), without fertilizer (53.50%), chemical (50.83%), worm (49.66%), and sheep manure (38.91%) in descending order. However, except cow manure, other fertilizers are in the same group. The mixtures that make up the artificial meadow-pasture are divided into 3 groups and the mixture with the highest rate of legume in the botanical composition is the mixture of cattle-2 (*Astragalus cicer, Trifolium pratense, Medicago falcata*) with 60.70% ratio. This is followed by a mixture of cattle-1 (*Trifolium pratense, Medicago falcata*) with a ratio of 51.87% and a ratio of ovine-poultry (*Trifolium repens*) with a ratio of 39.83% in descending order. When we look at the fertilizer x mixture intreactions, the highest value was found in the parcel where cattle-2 mixture and without fertilizer was applied with 65.50%. The lowest botanical composition ratio was obtained in cattle-1 mixture with 38.75% and the sheep fertilizer.

Bayram (2005), in a study conducted on the effects of ventilation, organic and commercial fertilizer applications on the grass yield, quality and botanical composition of the secondary character of pasture in Bursa conditions, stated that organic fertilizers increased the ratio of grains compared to fertilizer-free conditions, but the increases here were less than commercial fertilizers. The researcher has determined the lowest grasses in fertilizer-free conditions. There are small differences between the study that the researcher has done and the study we have done. This difference may be due to the organic fertilizer types used in our study, the plants used in the mixture and their proportions and ecological conditions. In the same study, it is claimed that fertilizer applications generally decrease the rate of legumes, and the most decrease is in commercial fertilizer applications. According to the same researcher, the highest ratio of legumes was obtained in conditions without fertilizer. Chicken fertilize, on the other hand, gave results close to fertilizer-free conditions. This study of the researcher and our study show similarities. In addition, many researchers have identi fied data in their research that support the results we obtained in our study (Nuno et al 1988; Grzegorczyk et al 1990; Vintu 1993; Kuzuoğlu and Çelik 1999; Hatipoğlu et al 2001). Jeangros and Thoni (1994), on the other hand, stated that organic fertilizers increased legume species, especially *Trifolium repens*, in all regions and suggested organic fertilizer applications for desirable botanical composition.

4. Conclusion

Our meadow and pasture areas are decreasing for many different reasons, and climax vegetation is deteriorating in existing areas and the ratio of desired plant species in the botanical composition is gradually decreasing. Invasive plants cover the meadows and pastures. Breeding methods such as top seeding and fertilization are used for the improvement of meadows and pastures. This study is also important because it includes the issue of suitable plant mixtures according to the animal type to be grazed and the fertilizers that can be applied to these mixtures. According to the results of the study, the botanical composition of the grasses was obtained from the mixture prepared for ovine- poultry (*Lolium perenne, Festuca rubra, Poa pratensis, Trifolium repens)* and sheep manure. The composition of the highest legume plants was obtained from cattle-2 (*Festuca arundinecea, Dactylis glomerata, Astragalus cicer, Trifolium pratense, Medicago falcata*) mixture and chicken manure. In our country, the use of organic fertilizers is rather limited compared to commercial fertilizers in forage crop farming. However, excessive and long-term use of chemical fertilizers, especially nitrogenous fertilizers, causes salinization in the soil, heavy metal accumulation, nutrient imbalance, deterioration of microorganism activity, eutrophication and nitrate accumulation in surface and ground waters (Sönmez et al 2008). According to this study, the fact that sheep and chicken fertilizers are more effective in botanical composition reveals that sheep and poultry manure can be used in meadow-pasture areas. Thus, both fertilizers will be evaluated and the desired species in botanical composition will be increased.

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6. References

Açıkgöz E (2001). Yembitkileri. (Yenilenmiş 3. Baskı). Uludağ Üniversitesi Güçlendirme Vakfı Yayın No: 182, Vipaş A. Ş. Yayın No: 58, İstanbul, 584 s.

Altın M, Gökkuş A, Koç A (2005). Çayır mera ıslahı. TC Tarım ve Köyişleri Bakanlığı Tarımsal Üretim ve Geliştirme Müdürlüğü.

Anonymous (2020). https://www.tarimorman.gov.tr/ (access date:04.11.2020).

Atış İ, Hatipoğlu R (2008). Çukurova sulu koşullarında suni mera tesisinde ak üçgülle (*Trifolium repens* L.) karışıma girebilecek çok yıllık buğdaygil yem bitkilerinin ve bunların en uygun karışım oranlarının saptanması. Çukurova Üniversitesi Fen Bilimleri Enstitüsü Dergisi 18: 84-93.

Avcıoğlu R, Hatipoğlu R, Karadağ Y (2009). Baklagil Yembitkileri. Ders Kitabı 3(2009): 310–353.

Baker RL, Powel J (1982). Effect of atrazine, fertilizer and 2, 4- D on winter grazing performances of beef cows on northcentral Oklahama tallgrass prairie, J. Range Manage, 35: 505-507.

Bakır Ö (1985). Çayır ve Mera Islahı. Ankara Üniversitesi Ziraat Fakültesi Yayınları: 947, Ankara.

Bayram G (2005). Bursa Koşullarında Havalandırma, Organik Ve Ticari Gübre Uygulamalarının Sekonder Karakterli Meranın Ot Verimi, Kalitesi Ve Botanik Kompozisyonuna Etkileri Üzerinde Bir Araştırma. Doktora Tezi, Uludağ Üniversitesi Fen Bilimleri Enstitüsü.

Berdahl DJ, Karn JK, Hendrickson, JR (2001). Dry matter yields of cool-season grass monocultures and grass-alfalfa binary mixtures. Agronomy Journal 93: 463-467.

Bilgili A, Koç A (2020). Sarıkamış Orman İçi Mera Bitki Örtülerinin Bazı Özelliklerinin Belirlenmesi. Atatürk Üniversitesi Ziraat Fakültesi Dergisi 51 (1): 88-96.

Briemle G (2000). Ansprache und Förderung von Extensiv- Grünland. Neue Wegezum Prinzip der Honorierung Ökologischer Leistungen der Landwirtschaft in Baden-Würtenberg-naturschutz und Landschaftsplanung 32. Jg. Nr.6 171-175 Ulmer-Verlag Stuttgart.

Büyükburç U (1980). Ankara İli Yavrucak Köyü Meralarının Gübreleme ve Dinlendirme Yolu İle Islah Olanakları Üzerinde Araştırmalar. Doktora Tezi, Sosyal Bilimler Enstitüsü, Ankara, Türkiye.

Can M, Ayan İ (2017). Domuz Ayrığı (*Dactylis glomerata* L.) Popülasyonlarında Gelişme Dönemlerine Göre Verim ve Bazı Özelliklerin Değişimi. KSÜ Doğa Bil. Derg. 20(2): 160-166.

Cosper H, Thomas R, Alsayegh JR (1967). Fertilization ve its effect on range improvement in the northern greatplains. J. Range Menagement, 20: 216-222.

Deak A, Hall MH, Sanderson MA, Archibadl DD (2007). Production and nutritive value of grazed simple and complex forage mixtures. Agronomy Journal 99: 814-821.

Elçi Ş (2005). Baklagil ve Buğdaygil Yem Bitkileri. *TC* Tarım ve Köyişleri Bakanlığı, 412-423.

Geçit H, Çiftçi C, Emeklier H, İncikarakaya S, Adak M, Kolsarıcı Ö, Ekiz H, Altınok S, Sancak C, Sevimay C, Kendir H (2009). Tarla Bitkileri A.Ü. Ziraat Fakültesi Yayınları. Yayın No: 1569 No:521, Ders Kitabı, Ankara.

Gedikli H (2019). Düzce Odayeri Yaylasında Botanik Kompozisyonun Belirlenmesi ve Bazı Islah Yöntemlerinin Ot Verimine Etkisi. Yüksek Lisans Tezi, Düzce Üniversitesi, Fen Bilimleri Enstitüsü.

Gökkuş A, Koç A (2001). Mera ve çayır yönetimi. Atatürk Ünv. Ziraat Fak. Ders Yay. No.228, Erzurum.

Gökkuş A (2014). Kurak Alanlarda Yapay Mera Kurulması ve Yönetimi. ÇOMÜ Zir. Fak. Derg. (COMU J Agric. Fac.) 2 (2): 151–158.

Gökkuş A (2018). Meralarımız ile ilgili bir değerlendirme. TÜRKTOB Dergisi 25: 6-8.

Grzegorczyk S, Benedycka Z, Benedyckı S, Mlynarczyk K, Gaborcık N, Krajcovıc V, Zımkova M (1990). Changes İn Vegetation of Permanent Pasture Under Differential Fertilization. Soil-Grassland-Animal Relationships.

Hatipoğlu R, Avcı M, Kılıçalp N, Kökten K, Çınar S (2001). Çukurova Bölgesindeki Taban Bir Merada Fosforlu Gübreleme ve Farklı Azot Dozlarının Ot Verimi ve Kalitesi İle Botanik Kompozisyona Etkileri Üzerinde Bir Araştırma. Türkiye 4. Tarla Bitkileri Kongresi, 17–21 Eylül, Tekirdağ, s. 1-6.

Holechek JL, Pieper RD, Herbel CH (2004). Range Management Principles and Practices. Pearson Education, Inc., New Jersey. 607 p.

Isselstein J, Röver K, Şahin D, Hoffmann M (2003). Einfluss der Beweidung mit Fleischrindern auf die Biodiversität von Grassland.

Jeangros B, Thonı E (1994). Use of Farmyard Manure on Permanent Pastures. Collation of Experimental Results and Recommendations for Switzerland. Fourrages, 140: 393-406.

Jung GA, Van Wij AJPK, Hunt WF, Watson CE (1996). Cool-season forage grasses. Agronomy Monograph no. 34. American Society of Agronomy, Crop Science Society of America, Soil Science Society of America, 677 S. Segoe Rd., Madison, WI53711, USA.

Karakurt E (2004). Ankara Kıraç Koşullarında Nohut Geveni (*Astragalus Cicer* L.) Hat ve Çeşitlerinde Ot Verimi ile Bazı Tarımsal Özellikler", Tarla Bitkileri Merkez Araştırma Enstitüsü Dergisi 10: 75-82.

Koç A, Gökkuş, A, Tan M, Çomaklı B, Serin Y (2004). Performance of tall fescue and lucerne-tall frescue mixtures in highlands of Turkey. New Zealand Journal of Agricultural Research 47: 61-65.

Kuzuoğlu E, Çelik N (1999). Karacabey Şartlarında Çayır Alanlarının Azotlu Ve Fosforlu Gübre İsteklerinin Belirlenmesi Üzerinde Bir Araştırma. Türkiye 3. Tarla Bitkileri Kongresi, 15–18 Kasım, Adana, s. 41-46.

Manga İ, Acar Z, Ayan İ (2002). Buğdaygil Yem Bitkileri. Ders Kitabı, Samsun 6:207-216.

Nuno MI, Antuna A, Roza MB, Martınez A, Argamenterıa A (1988). Nitrogen Fertilization of Grazed Native Pastures of Asturias Coastal Area. I. Maximum Nitrogen Rates for Grazing, Revista-Pastos Vol: 1-2, p. 109-135.

Palta Ş, Altintaş GA (2018). Bartin İli Mera Islah Çalişmalarinda Kullanilan Yem Bitkileri ve Genel Özellikleri. Bartın University International Journal Of Natural And Applied Sciences 1 (1): 48-55.

Palta Ş, Lermi A (2019). Mera Islah Uygulamasının Değişim Seyrinin Belirlenmesi: Bartın İli Serdar Köyü Örneği. ÇOMÜ Zir. Fak. Derg. 7(2): 229-238.

Reis M (2002). Trabzon Yöresi Alpin Meralarında Azot, Fosfor ve Potasyumlu Gübrelerin Vejetasyon Yapısı Üzerindeki Etkilerinin Araştırılması.

Doktora Tezi, Karadeniz Teknik Üniversitesi, Fen Bilimleri Enstitüsü, Trabzon.

Rubıo HO, Wood MK, Gomez A, Reyes G (1996). Native Forage Quality, Quantity and Profitability as Ed by Fertilization İn Northern Mexico. Journal of Range Management, 49 (4): 315-319.

Sleugh B, Moore KJ, George JR, Brummer EC (2000). Binary legume-grass mixtures improve forage yield, quality, and seasonal distribution. Agronomy Journal 92*:* 24-29.

Sönmez İ, Kaplan M, Sönmez S (2008). Kimyasal gübrelerin çevre kirliliği üzerine etkileri ve çözüm önerileri. Derim 25 (2): 24-34.

Tan M (2018). Baklagil ve Buğdaygil Yem Bitkileri. Erzurum Atatürk Üniversitesi Ziraat Fakültesi Ders Yayınları No: 256, Erzurum.

Tutar H, Kökten K (2019). Mera Vejetasyon Özelliklerinin Farklı Yöneylere Göre Değişimi. Türkiye Tarımsal Araştırmalar Dergisi 6 (3): 312-318.

Tükel T, Hatipoğlu R, Hasar E, Çeliktaş N, Can E (1996). Azot ve Fosfor Gübrelemesinin Çukurova Bölgesinde Tüylü Sakalotu'nun (Hyparrhenia hirta (L.) Satpf.) Dominant Olduğu Bir Meranın Verim ve Botanik Kompozisyonuna Etkileri Üzerinde Bir Araştırma. Türkiye 3. Çayır- Mera ve Yembitkileri Kongresi, 17-19 Haziran, Erzurum, s. 59-65.

Uslu ÖS (2005). Kahramanmaraş İli Türkoğlu İlçesi Araplar Köyü Yeniyapan Merasında Botanik Kompozisyonun Tespiti ve Farklı Gübre Uygulamalarının Meranın Verim ve Botanik Kompozisyonuna Etkileri Üzerinde Araştırmalar. Doktora Tezi, Çukurova Üniversitesi, Fen Bilimleri Enstitüsü.

Vintu V (1993). Increase in Yields of Festuca valesiaca Pastures in the Jiia-Bahlui Basin with Organic and Mineral Fertilizer Applications. Cercetari-Agronomice-in- Moldova. 26 (2): 110-116.

Yavuz R (2007). Düzce Esenli Merasında Bazı Islah Yöntemlerinin Verimliliğe Etkisi. Yüksek Lisans Tezi, Düzce Üniversitesi Yayınları, Düzce.