THE EFFECTS OF COMMON VETCH (*Vicia sativa* L.) AND TRITICALE (X *Triticosecale* Wittmack.) MIXTURE RATES ON HAY YIELD AND QUALITY UNDER BINGOL CONDITIONS

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Department of Field Crops

Adviser: Associate Prof. Dr. Kağan KÖKTEN
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BINGOL UNIVERSITY
INSTITUTE OF SCIENCE

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This thesis has been accepted on the date of 26.12.2016 by a unanimous vote by the below jury.

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FOREWORD

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Bingöl 2016

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SYMBOLS AND ABBREVIATIONS LIST

g	: Gram
kg	: Kilogram
da	: Decar
ha	: Hectare
km	: Kilometer
mm	: Millimeter
cm	: Centimeter
t	: Ton
N	: Nitrogen
P	: Phosphor
K	: Potassium
CP	: Crude protein
ADF	: Acid Detergent Fiber
NDF	: Neutral Detergent Fiber
CV	: Variation coefficient
Ca	: Calcium
Mg	: Magnesium
Na	: Sodium

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BİNGÖL KOŞULLARINDA ADİ FİĞ (*Vicia sativa* L.) İLE TRİTİKALENİN (X *Triticosecale* Wittmack.) KARIŞIM ORANLARININ OT VERİMİ VE KALİTESİNE ETKİLERİ

ÖZET

Bingöl koşullarında 2016 yılında yürütülen bu çalışmada Adi Fiğ (*Vicia sativa* L.) ile Tritikalenin (X *Triticosecale* Wittmack.) karışım oranlarının ot verimi ve kalitesine etkileri incelenmiştir.

Çalışmada bitki materyali olarak Dicle Üniversitesi Ziraat Fakültesi Tarla Bitkileri Bölümünden temin edilen Görkem adi fiğ çeşidi ve GAP Uluslararası Tarımsal Araştırma ve Eğitim Merkezi Müdürlüğü'nden temin edilen Tacettin Bey tritikale çeşidi kullanılmıştır. Araştırma tesadüf blokları deneme desenine göre üç tekrarlamalı olarak kurulmuştur. Araştırmada; adi fiğde sap uzunluğu, tritikale bitki boyu, yeşil ot verimi, yeşil otta fiğ oranı, kuru ot verimi, kuru otta fiğ oranı, oransal verim toplamı, ham protein oranı, ham protein verimi, ham kül oranı, ADF, NDF, sindirilebilir kuru madde, kuru madde tüketimi, nisbi yem değeri, fosfor, potasyum, kalsiyum, magnezyum ve sodyum gibi özellikler incelenmiştir. İncelenen bazı özellikler arasında (magnezyum ($P\leq0,05$), yeşil ot verimi, yeşil otta fiğ oranı, kuru ot verimi, kuru otta fiğ oranı, oransal verim toplamı, ham protein oranı, ham protein verimi, ham kül oranı, ADF, NDF, sindirilebilir kuru madde, kuru madde tüketimi ve nisbi yem değeri ($P\leq0,01$)) istatistiki olarak önemli farklılıklar saptanmıştır.

Araştırma sonucunda; karışımların adi fiğ sap uzunlukları 56,40-61,23 cm, tritikale bitki boyu 77,60-87,73 cm, yeşil ot verimi 769,78-1090,67 kg/da, yeşil otta fiğ oranı %6,51-100,00, kuru ot verimi 290,83-644,24 kg/da, kuru otta fiğ oranı %11,01-100,00, oransal verim toplamı 1,00-1,40, ham protein oranı %6,14-21,20, ham protein verimi 29,97-98,46 kg/da, ham kül oranı %5,75-9,73, ADF %31,20-42,21, NDF %51,99-66,44, sindirilebilir kuru madde %56,20-64,59, kuru madde tüketimi %1,81-2,31, nisbi yem değeri 78,43-114,21, fosfor %0,107-0,167, potasyum %0,642-0,864, kalsiyum %0,68-1,14, magnezyum %0,205-0,322 ve sodyum %0,007-0,032 arasında belirlenmiştir.

Bu çalışma sonuçlarına göre, Bingöl koşullarında en düşük ADF ve NDF oranı ve en yüksek sindirilebilir kuru madde, kuru madde tüketimi ve nisbi yem değeri bakımından en uygun karışımın %60 fiğ + %40 tritikale karışımı olabileceği sonucuna varılmıştır.

Anahtar Kelimeler: Adi fiğ (*Vicia sativa* L.), tritikale (X *Triticosecale* Wittmack, karışım, ot verimi, ham protein oranı.

EFFECTS ON HAY YIELD AND QUALITY OF COMMON VETCH (*Vicia sativa* L.) AND TRITICALE (X *Triticosecale* Wittmack.) MIXTURE RATES IN BINGOL CONDITIONS

ABSTRACT

Conducted under Bingol conditions during the 2016 growing season, this study is aiming to analyze the effect of common vetch (*Vicia sativa* L.) and triticale (X *Triticosecale* Wittmack.) mixture ratios on hay yield and quality.

Plant materials of the study were Gorkem common vetch variety, obtained from Department of Field Crops, Faculty of Agriculture, Dicle University, and Tacettin Bey Triticale variety, obtained from GAP International Agricultural Research and Training Center. The research has been established as a randomized complete block experimental design with three replications In the study; vetch stem length, triticale plant height, green herbage yield, vetch rate in the green herbage, dry hay yield, vetch rate in the hay, relative yield total, crude protein ratio, crude protein yield, crude ash ratio, acid detergent fiber (ADF), neutral detergent fiber (NDF), dry matter digestibility (DMD), dry matter intake (DMI), relative food value (RFV), phosphorus (P), potassium (K), calcium (Ca), magnesium (Mg) and sodium (Na) have been analyzed. The results of variance analyses indicated statistically significant differences among some characters (magnesium ($P \leq 0.05$), green herbage yield, vetch rate in the green herbage, dry hay yield, vetch rate in the hay, relative yield total, crude protein ratio, crude protein yield, crude ash ratio, ADF, NDF, dry matter digestibility, dry matter intake and relative food value ($P \leq 0.01$)).

The findings of the study indicated that vetch stem length of the mixtures ranged between 56.40 and 61.23 cm, triticale plant height ranged from 77.60 to 87.73 cm, green herbage yield from 769.78 to 1090.67 kg/da, vetch rate in green herbage from 6.51% to 100.00%, dry hay yield from 290.83 to 644.24 kg/da, vetch rate in hay from 11.01 to 100.00%, relative yield total from 1.00 to 1.40, crude protein ratio from 6.14 to 21.20%, crude protein yield from 29.97 to 98.46 kg/da, crude ash ratio from 5.75 to 9.73%, ADF from 31.20 to 42.21%, NDF from 51.99 to 66.44%, dry matter digestibility (DMD) from 56.20 to 64.59%, dry matter intake (DMI) from 1.81 to 2.31%, relative food value (RFV) from 78.43 to 114.21, phosphorus (P) from 0.107 to 0.167%, potassium (K) from 0.642 to 0.864%, calcium (Ca) from 0.68 to 1.14%, magnesium (Mg) from 0.205 to 0.322% and sodium (Na) values ranged from 0.007 to 0.032%.

Based on the findings of this study, we can conclude that a mixture ratio of 60% vetch + 40% triticale may be the best mixture ratio in terms of highest dry matter digestibility, dry matter intake and relative food value and the lowest rates of ADF and NDF for Bingol and other similar ecological regions.

Keywords: Common vetch (*Vicia sativa* L.), triticale (X *Triticosecale* Wittmack.), mixture, hay yield, crude protein ratio.

1. INTRODUCTION

Most basic needs of human are adequate and balanced nutrition. For a person to have a balanced diet, he needs an average of 70 gram protein intake per day. Of this amount, half of the protein needs to be herbal and the other half needs to be animal sourced (Tekinel 1984). Because some of the amino acids required for human body are not plenty in herbal food, their digestibility ratio is low, and this leads to a reduction of herbal proteins usage ratio in body, when compared to animal proteins. These reasons make animal products irreplaceable for humans, and they are incomparable with other food substances.

Nowadays the amount of animal product consumed by each person is one of the most important indicators that are used to determine the level of development of a country. In developed countries such as USA and EU member states, the amount of animal product consumed by each person is very high. But in Turkey, the figures are contrasting (FAO 2001).

The reason for people in Turkey to consume low amounts of animal protein is because production of animal products is insufficient hence leading to very high prices, exceeding the purchasing power of people. Several problems faced by stockbreeding in Turkey leads to insufficient production of animal products. Biggest problem faced by stockbreeding in this country is the poor nutrition of stocks.

Developed countries attain great importance to forage crops and meadow and pasture farming when it comes to feeding. But in our country, feeding of the animals is mostly based on natural pastures and meadows, which became less productive due to over-grazing, grain hay and stubble (Tükel and Hatipoğlu 1997). Production levels of forage plant are very low among field agriculture.

Farmers in our country are yet to realize the importance of forage plants, which is leading to a slow development of forage plant farming, despite it's importance in animal feeding. As well as playing an important role in animal feeding, forage plants are also enhancing the physical and chemical characteristics of the field soil, hence increasing the yield and quality of the following crop plant and preventing the spread of diseases and pesticides. As such, forage plants reduce the amount of pesticides and fertilizers used in the soil.

Many researchers trying to explore ways to improve forage plant production within field agriculture of Turkey have been conducting studies and researches for many years to reveal and improve these positive aspects of forage plants. Some of these researches are aiming to maximize the use of soil and natural structures found in the scant agricultural lands of ours. As an outcome of all these studies, planting the forage plants as a mixture of graminae and legume has appeared as an alternative.

In order to reach the target of achieving great amounts of high quality grass yield by planting forage plants, particularly as a mixture of legume and graminae, as part of the field agriculture, it is inevitable to well determine the ratios of the cultivars within the mixture.

This study has been conducted with the aim of determining the most suitable mixture ratio for common vetch + triticale to be planted in Bingöl conditions.

2. SUMMARY OF SOURCES

In a study conducted on the feed production potentials of annual legume + oat mixtures in different times of the year in Cukurova; hairy vetch, Hungarian vetch, grass pea, fodder pea and berseem have been planted by mixing with oat. Harvests took place on the 15th of March, 1st April and 15th April, and at the end of the study it was decided that 1st of April was the ideal time for harvesting. The harvests made on this date indicated that hairy vetch + oat mixture containing 42% legume and yielding 904,3 kg/da dry hay and grass pea + oat mixtures containing 44% legume and yielding 901,8 kg/da dry hay yield were superior than others (Tükel and Hatipoğlu 1987).

In a study conducted to determine the most suitable mixture ratio in common vetch and grain mixtures in Samsun ecologic conditions; it has been determined that in order to achieve a high dry hay and crude protein yield oat ratio should not exceed 60%, and barley and triticale ratio should not exceed 40%. It has also been reported that when compared to the mixtures, single variety planting yielded less dry hay and in vetch + triticale mixtures, dry hay yield and protein yield decreased when triticale ratio was increased (Aydın and Tosun 1991).

In a study examining the effect of mixture ratio in vetch + triticale mixture under Cukurova bottom conditions and harvesting time on yield and agricultural characteristics; it has been reported that vetch plant height is effected by the mixture ratios and vetch is taller in mixtures compared to pure sowing, but triticale plant height is not effected by the mixture ratio, highest fresh hay yield was acquired from 50% vetch + 50% triticale mixture while highest dry hay yield was acquired from 25% vetch + 75% triticale mixture, highest crude protein ratio was acquired from pure vetch sowing, while highest crude protein yield was acquired from pure triticale sowing (Hasar 1992).

In a study examining the effect of mixture ratio in vetch + triticale mixture under Cukurova bottom conditions and harvesting time on fodder yield and quality and the effect of mixture elements on seed yield; the highest green herbage yield (2892.0 kg/da) and crude protein yield (97.58 kg/da) have been acquired from 50% vetch + 50% triticale mixture, while the highest dry hay yield (846.4 kg/da) was acquired from 25% vetch + 75% triticale mixture. At the end of the study, it has been determined that vetch + triticale mixture is the most ideal for winter period, and this mixture shall contain 25% or 50% vetch. In addition, it has been revealed that by considering the sowing time of the plant to be sowed after the hay harvesting, harvesting could be delayed (Hasar and Tükel 1994).

In a study based on different vetch + grain mixtures cultivated with a 3:1 mixture ratio in Aydın conditions; two triticale varieties have been analysed, and the pure sowing of one of them, Beaguelita, returned 3522 kg/da green herbage yield, 10.27% crude protein ratio and 102.4 kg/da crude protein yield. The mixture of the variety with vetch returned 3791 kg/da green herbage yield, 10.86% crude protein ratio and 81.7 kg/da crude protein yield. The other triticale variety on the other hand, Eronga, provided 3662 kg/da green herbage yield, 9.45% crude protein ratio and 92.3 kg/da crude protein yield in pure sowing but when mixed with vetch, 3952 kg/da green herbage yield, 11.43% crude protein ratio and 88.1 kg/da crude protein yield were acquired (Konak et al. 1997).

In a study aiming to determine the most suitable mixture ratio in vetch (*Vicia sativa* L.) and triticale (*Triticum x Secale*) mixtures to be planted in Diyarbakır conditions; the highest fresh hay (3447.6 kg/da) and dry hay yield (968.4 kg/da) were acquired from 40% vetch + 60% triticale mixture, highest crude protein ratio (22.5%) was acquired from pure vetch planting while the highest crude protein yield was acquired from 80% vetch + 20% triticale mixture (110.87 kg/da) (Çil 1998).

In a study aiming to determine the most suitable seed mixture ratio in vetch and triticale mixture to be planted in Afşin conditions; it has been reported that in terms of dry hay yield (1427.0 kg/da) and crude protein yield (120.63 kg/da) the most suitable mixture is 25% vetch + 75% triticale mixture (Kılıç 1999).

In a study analysing the effects of different nitrogen and phosphor dosages in Diyarbakır conditions in vetch + triticale (40% vetch + 60% triticale) mixture on hay yield and quality; the fresh hay (3102.5 kg/da), dry hay (1031.8 kg/da) and crude protein yield (182.8 kg/da) values in 4 kg/da nitrogen dosage were statistically higher than the values acquired from the parcels where no nitrogen was applied (Çil 2000).

In a trial aiming to determine the effects of mixture ratio and plant density in mixed planting of triticale and common vetch on yield and yield components; it has been reported that in terms of dry hay yield and crude protein yield the 60% vetch + 40% triticale mixture could be preferred and harvesting should take place once the lower beans of vetch become visible (Sayılgan 2002).

In a study examining the effects of plant spacing and different mixture ratios in vetch + triticale mixture in arid conditions of Cukurova on hay yield and quality; it has been determined that plant spacing and mixture ratio have great effects on dry hay yield, vetch ratio on dry hay, as well as relative yield total values and crude protein yield characteristics. It has also been revealed that the level of this effect varied per year. For the arid conditions of Cukurova, it has been concluded that in terms of dry hay yield, relative yield total and crude protein yield of the mixture, the most suitable vetch + triticale mixture is 25% vetch + 75% triticale mixture planted in 400 seed/m^2 plant spacing (Kökten et al. 2003).

In a study analysing the effects of the nitrogen and phosphor fertilizing under Cukurova's arid conditions, the effect of 8 kg/da vetch + 10 kg/da triticale mixture on dry hay yield, vetch mixture's effect on dry hay yield connection ratio and on crude protein yield; it has been revealed that nitrogen x phosphor interaction is important, highest dry hay yield and crude protein yield has been acquired from the parcels applied 4 kg/da nitrogen+4 kg/da phosphor in the first year, while during the second year, 4 kg/da phosphor application returned the highest crude protein yield, contribution of vetch mixture on dry hay yield was higher in both years compared to planting ratio, nitrogen application lead to a reduction in vetch ratio. Based on the study findings, it has been revealed that from the vetch + triticale mixture to be planted in Cukurova's

arid conditions, a 60% increase in dry hay yield would be possible by applying 6 kg/da nitrogen + 4 kg/da phosphor (Kökten et al. 2005).

In a study where vetch was cultivated in two different mixture ratios with triticale and oat (55:45, 65:35, vetch:grain); highest hay yield was acquired from pure grain planting, pure grain planting produced more hays than pure vetch and mixtures, and in terms of proportional yield totals, only 65 vetch : 35 oat mixture produced les advantage than pure planting. The study also indicated that in terms of quality criteria (NDF, ADF, lignin content, dry matter digestibility, dry matter intake and relative food value) mixture applications are important and highest quality fodder is acquired from pure vetch planting and mixtures containing high levels of vetch (Lithourgidis et al. 2006).

In a study where vetch has been cultivated in two different mixture ratios with triticale, wheat, barley and oat (55:45, 65:35, vetch:grain) where each of them was cultivated in pure form; it has been observed that mixtures are more advantageous than pure cultivation, oat and barley are more competitive than wheat and triticale in terms of aggression and competition ratio, hence vetch ratio is higher in mixtures made with wheat and triticale (Dhima et al. 2007).

In a two year study aiming to ascertain that mixed planting of grains with legumes is a common method in many parts of the world to produce fodder and food, and aiming to plant common vetch (*Vicia sativa*), winter wheat (*Triticum aestivum*), triticale (*X Triticosecale*), barley (*Hordeum vulgare*) and oat (*Avena sativa*) in pure form or by mixing with common vetch at a 35:65 (grain:common vetch) seed ratio to see their fighting power against pure grain; it has been observed the oat plants that develop in the common vetch 9 weeks after planting, display less development than those found in the pure planted grains, the oat plants that develop in the mixed planting of common vetch and grains do not have any effect on the oat plant that develop in the purely planted grain and common vetch, the dry hay yield acquired from the harvest of purely planted grain was higher than that acquired from the purely planted common vetch, triticale and oat mixture resulted in more dry hay yield than the winter wheat and barley mixture, but in most cases, mixture planning reduced the amount of total dry hay yield when compared to pure planting. According to the study findings; the mixed planting of 4

winter grains with oat did not have any significant effect on competition when compared to pure oat, but pure planted common vetch had the most pressing effect against oat when compared to other grains planted in pure or mixed form (Vasilakoglou et al. 2008).

In a study conducted to determine the most suitable mixture ratios of vetch and triticale under dry conditions in eastern Mediterranean region; based on the outcomes of a two year research determining the pure and mixture seed ratios of vetch and triticale (80% vetch + 20% triticale, 60% vetch + 40% triticale, 40% vetch + 60% triticale, 20% vetch + 80% triticale), highest dry fodder was acquired from seed mixture ratios of 20% vetch and 80% triticale under Adana conditions, but the study held in Kozan with a mixture ratio of 40% vetch + 60% triticale provided the highest dry fodder where the average vetch content was 23.5%, and the vetch content inside the dry fodder was determined as 10%, and the proportional total yield for the above given mixture ratios were 1.12 and 1.20. In conclusion, the above mixture rates can be recommended for Adana and Kozan Regions (Kökten et al. 2009).

In a study related to the seed mixtures ranging between 10-90% in vetch + triticale mixed planting and conducted at the Cukurova Agricultural Research Institute during the Mediterranean Region's winter period in 2004-2007; based on the three yield average, the highest crude protein production was 138.38 and 133.93 kg/da and the seed mixture was 90% vetch + 10% triticale and 80% vetch + 20% triticale. The study revealed that crude protein yield was higher in trials with 80-90% vetch mixture, vetch + triticale mixture ratio should be 80-90% to gain higher quality fodder by considering protein ratio and yield, and to ensure fodder with higher energy, ratios with higher triticale mixture has been recommended (Yücel and Avcı 2009).

In a study conducted with barley, triticale, vetch and grass pea; the cultivars have been planted in pure form and in a 50:50 ratio mixture with legume + grain and then harvested in two different periods. The study has indicated that mixed cultivation has more advantages than pure cultivation, legume ratios of the mixtures formed with triticale are higher, and in terms of aggressiveness values, common vetch and triticale are the dominant cultivars in the mixtures (Rakeih et al. 2010).

3. MATERIAL AND METHOD

3.1. Material

3.1.1. The Analysed Line and the Variety Providing Institutions

The plant materials used in the study were Görkem common vetch variety provided by Dicle University Faculty of Agriculture Department of Field Crops and Tacettin Bey Triticale variety provided GAP International Agricultural Research and Training Centre.

3.1.2. Characteristics of the Trial Zone

This trial was conducted at the trial zone of Genç Vocational High School under dry conditions in 2016.

3.1.2.1. Climate Conditions of the Research Zone

Table 3.1. Some of the yearly and monthly average climate figures for 2016 of Bingöl

Months	Average Temperature (°C)		Total Precipitation (mm)		Relative Humidity (%)	
	Long Years	2016	Long Years	2016	Long Years	2016
January	-2.4	-2.8	136.0	256.8	72.3	75.2
February	-1.5	2.3	136.4	113.0	72.1	72.5
March	3.8	7.1	129.1	131.0	67.0	58.9
April	10.7	14.3	120.5	46.8	62.8	47.0
May	16.3	16.5	75.8	66.2	55.8	55.9
June	22.1	23.3	21.2	34.4	43.7	43.5
Total/Ave.	**8.2**	**10.1**	**619.0**	**648.2**	**62.3**	**58.8**

Source: Anonym 2016 General Directorate of Meteorology (Bingöl)

Climate values of Bingöl are provided in Table 3.1. As seen in the table, the average temperature of first six months in Bingöl is 8.2 ^{o}C. According to the annual averages, the coldest month is January and the warmest month is June. On the other hand, the average temperature for the first six months of 2016 was 10.1 ^{o}C, again the coldest month was January and the warmest month was June. Looking at the first six months of 2016, when the study took place, the only month with an average temperature below was 0 ^{o}C January, while February, March, April, May and June had higher temperature averages than previous years. Looking at all these data, it is possible to say that the first six months of 2016 was warmer than previous years in the province of Bingöl.

During the months of February, April and May of 2016, the total precipitation was lower than previous years. So the total precipitation level of the first six months of 2016 was higher than the total precipitation levels of the first six months of previous years.

In terms of relative humidity values, the average of previous years was 62.3% but during the first six months of 2016 this value became 58.8%, lower than the average of previous years.

In conclusion, we can say that in Bingöl the first six months of 2016 had lower humidity but higher temperature and precipitation levels compared to previous years.

3.1.2.2. Soil Characteristics of the Research Area

The soil samples taken from the trial zone (from 0-20 cm depth); have been analysed at Bingöl University Faculty of Agriculture Department of Soil Science and Plant Nutrition Laboratories and analysis results have been given in Table 3.2.

Table 3.2. Soil characteristics of trial zone

Texture	Saturation (%)	Salinity (%)	Organic Matter (%)	$CaCO_3$ (%)	K_2O (kg/da)	P_2O_5 (kg/da)	pH
Loamy	38.38	0.0034	0.26	0.55	22.52	12.17	7.22

As the table suggests, the study area has loamy soil texture without any salinity problems and soil pH value is around neutral. Organic matter content is at a very low level, lime and potassium content is insufficient while phosphor content is high (Sezen 1995; Karaman 2012).

3.2. Method

3.2.1. Trial Method

The trial took place during the April 2015 - June 2015 period. Planting for the trial took place during first week of April and harvest was done during second half of June. The study was based on randomized complete block experimental design with 3 repetitions. Parcel areas in the trial have been defined as 0.8 m x 5 m= 4 m^2. The trial has been planted by using a hand marker into 4 rows of 5 m each, in 20 cm intervals. The amount of seeds used in planting were arranged to have 20 kg triticale and 10 kg vetch per decare. Right before planting, 4 kg nitrogen (N), 8 kg phosphor (P_2O_5) fertilizer was applied over pure matter per decare.

Once planting was completed, a hoe was used to fight against weed in parcels throughout the cultivation season. In order to determine the yield characteristics in trial parcels, as specified clearly below, monitoring and studies took place on 5 randomly selected plants from each parcel.

3.2.2. Analysed Characteristics

3.2.2.1. Stem Length in Common Vetch (cm)

It has been done by using 5 common vetch plants randomly selected from each parcel. When measuring the stem length in common vetch; the method defined by Anlarsal (1987) has been used, measuring the distance from soil surface to last bud gap in cm. The stem length average of 5 common vetches from each parcel has been taken to calculate common vetch stem length for a particular parcel.

3.2.2.2. Triticale Plant Height (cm)

It has been done by using 5 triticale plants randomly selected from each parcel. For triticale plant height measurement; the method adopted by Yağbasanlar (1987) has been used, and the distance between soil surface and last spikelet gap has been measured in cm. The plant height average of 5 triticale plants from each parcel has been taken to calculate the triticale plant height for a particular parcel.

3.2.2.3. Green Herbage Yield (kg/da)

Hay harvesting of the trial took place once the lower beans of the common vetch started to appear. Before harvesting started, the two side rows of the 4 rows in each parcel and 50 cm from each end have been removed as edge effect and a net area of 1.6 m^2 has been harvested by a grass hook. The green herbage harvested from each parcel has been weighed by a scale, and the green herbage yield for that particular parcel has been defined. Then the green herbage yields of each parcel have been converted into green herbage yield per decare.

3.2.2.4. Common Vetch Ratio in Green Herbage (%)

The green herbage harvested from each mixture parcel has been divided into components, as common vetch and triticale, and the green weight of each component has been weighed. The green herbage weight of the common vetch measured for each parcel has been proportioned to the total green herbage yield of that particular parcel and calculated as common vetch ratio % in green herbage.

3.2.2.5. Dry Hay Yield (kg/da)

From the green herbages harvested from each parcel and divided into components, 0.5 kg vetch and 0.5 kg triticale green herbage samples have been dried in a drying chamber at 70^oC until the weight was fixed. The weights of dried hay samples have been recorded and by performing the necessary conversions, common vetch dry hay yield and triticale dry hay yields per parcel have been defined. The total of the common vetch dry hay yield

and triticale dry hay yield per parcel has been calculated as the total dry hay yield for a particular parcel. Then, the dry hay yields acquired from the parcel have been converted into dry hay yield per decare.

3.2.2.6. Common Vetch Ratio in Dry Hay (%)

Common vetch dry hay yield acquired from each mixture parcel has been proportioned to the total dry hay yield of the particular parcel to calculate the common vetch ratio in dry hay in %.

3.2.2.7. Relative Yield Total (RYT)

Relative yield total is accepted as a scale of measuring the effectiveness by the varieties making up the mixture, for using the ecologic sources in the mixture, and by using the formula defined by De Wit and Van den Bergh (1965) and taking the dry hay yields of the mixtures it has been calculated as shown below.

RYT = YFA / YFF + YAF / YAA
RYT = Relative Yield Total
YFA = Dry hay yield of common vetch in the mixture
YFF = Dry hay yield of common vetch in pure sowing
YAF = Dry hay yield of triticale in the mixture
YAA = Dry hay yield of triticale in pure sowing

3.2.2.8. Crude Protein Ratio (%)

The dried hay samples taken to determine the dry hay yield in each parcel have been subjected to nitrogen analysis as per the Kjeldahl method defined by Kaçar (1977). The nitrogen % values defined in the samples have been multiplied by 6.25 coefficients to calculate the crude protein ratio % in each sample. The crude protein ratio value defined in each parcel for each mixture component has been used along with the below given equation to define the crude protein ratio of the hay in each parcel.

3.2.2.9. Crude Protein Yield (kg/da)

The crude protein ratio defined for each parcel has been multiplied by the dry hay yield of that particular parcel to calculate the crude protein yield of that parcel and the crude protein yield per decare by making the necessary conversions.
Crude protein yield = (crude protein ratio of vetch x dry hay ratio of vetch) + (crude protein content of triticale x dry hay ratio of triticale).

3.2.2.10. Crude Ash Ratio (%)

All the matters that are left behind unburned after burning the dry matter are collectively called ‘’crude ash‘’ (Kutlu 2008). The samples, milled after being dried, have been burned in a furnace at 550^{o}C for 12 hours to define the crude ash ratio in dry hay.

3.2.2.11. Acid Detergent Fiber (ADF) Value (%)

ADF solution is prepared for ADF analysis. Filter bags are first weighed when empty. Then about 0.5 gr of the sample that have been grained in a mill with 1 mm sieve diameter is weighed and placed into these filter bags and the bag is shut before re-weighing the sample. The weighed samples are placed into the device (ANKOM 200 Fibre Analyser), pre-prepared solution is added and the device is run. After boiling at 100^{o}C for 60 minutes, the samples are rinsed twice with hot water and once with cold water for 5 minutes each time, and then the samples are kept in acetone for 3 minutes. After evaporating the acetone, samples are kept in an oven at 105^{o}C for 2-4 hours, and upon reaching room temperature at desiccator, samples are weighed and calculated by using the formula defined by Van Soest (1963).

3.2.2.12. Neutral Detergent Fiber (NDF) Value (%)

NDF solution is prepared for NDF analysis. Filter bags are first weighed when empty. Then about 0.5 gr of the sample that have been grained in a mill with 1 mm sieve diameter is weighed and placed into these filter bags and the bag is shut before re-weighing the sample. The weighed samples are placed into the device (ANKOM 200

Fibre Analyser), pre-prepared solution is added and the device is run. After boiling at 100ºC for 60 minutes, the samples are rinsed twice with hot water and once with cold water for 5 minutes each time, and then the samples are kept in acetone for 3 minutes. After evaporating the acetone, samples are kept in an oven at 105ºC for 2-4 hours, once reaching room temperature at desiccator, samples are weighed and calculated by using the formula defined by Van Soest and Wine (1967).

3.2.2.13. Dry Matter Digestibility (DMD)

The dry matter digestibility ratio calculated by using the ADF ratio has been acquired by the help of the below formula (Morrison 2003).

Dry matter digestibility (DMD) = 88.9-(0.779x%ADF) (3.1)

3.2.2.14. Dry Matter Intake (DMI)

5 gram samples taken from the samples grained for quality analysis are dried in oven at 105ºC for 24 hours, cooled in a desiccator and weighed in an assay balance. The acquired data have been registered as dry matter contents. These values have been proportioned to dry hay samples to calculate the dry matter yield per decare (Morrison 2003).

Dry Matter Intake (DMI) = 120/(NDF%) (3.2)

3.2.2.15. Relative Feed Value (RFV)

It is a quality scale widely used in fodder plants. It has been calculated as below by using ADF and NDF ratios (Morrison 2003).

Relative food value = (DMD x DMI)/1.29 (3.3)

3.2.2.16. P (Phosphor), K (Potassium), Ca (Calcium), Mg (Magnesium) and Na (Sodium) Values

Among the analysed mineral matter characteristics, Ca, K, Mg, Na and P values are highly important elements in animal feeding. The ratios of Ca, K, Mg, Na and P values in fodders directly affect quality.

3.2.3. Statistical Model and Assessment Method

The statistical analyses of the data belonging to the analysed characteristics have been performed in accordance with randomized complete block experimental design with 3 repetitions, by using the Jump (the software of SAS program) package program. The statistically significant factor averages, based on variance analysis results, have been compared with LSD test (SAS 1999).

4. RESULTS AND DISCUSSION

4.1. Common Vetch Stem Length (cm)

The variance analysis results of the common vetch stem length values measured at pure common vetch and four different vetch + triticale mixtures parcels are given in Table 4.1.

Table 4.1. The effect of mixture rate in pure vetch and vetch + triticale mixtures on common vetch stem length and the related variance analysis results

Variance Source	Degree of Freedom	Squares Total	Squares Average	F Value
Repetition	2	39.537333	19.7686	0.4577
Mixture Ratio	4	65.317333	16.3293	$0.6059^{N.S.}$
Error	8	183.24267	22.9053	
General	14	288.09733		

F values marked with N.S. are insignificant at 5% ($P \geq 0.05$).

As the table suggests, mixture ratio does not have a statistically significant effect on common vetch stem length. The common vetch stem length averages detected in pure vetch and different mixtures are given in Table 4.2.

As seen in the table, vetch stem length has ranged between 56.40 cm and 61.23 cm in pure vetch and vetch + triticale mixture ratios. The common vetch stem length average in pure vetch and vetch + triticale mixtures in different ratios has been defined as 58.55 cm.

Studies related to common vetch + triticale mixtures in different parts of Turkey have provided different common vetch stem length values. For example, the common vetch stem length values we have acquired were lower than those acquired by Acar (1995)

98.3-120.0 cm Çil (1998) 90.23 cm, Kılıç (1999) 112.52 cm and Şahin and Babaç (1990) 70.7-99.3 cm; but higher than those of Karaca and Çimrin (2002) 23.5-28.5 cm and similar to that of Çil (2000), 57.3-61.7 cm. The differences between our findings and those of the other researchers could be attributed to the fact that varieties and mixture ratios used in the trials were different or the climate and soil conditions of the trial zone.

Table 4.2. Stem length (cm) averages detected in common vetch found in pure sowing and different vetch + triticale mixtures

Mixture Ratios	**Vetch Stem Length (cm)**
100% Vetch	61.23
80% Vetch + 20% Triticale	56.60
60% Vetch + 40% Triticale	57.67
40% Vetch + 60% Triticale	56.40
20% Vetch + 80% Triticale	60.87
Average	**58.55**

4.2. Triticale Plant Height (cm)

The variance analysis results of the triticale plant height values measured at pure triticale and four different vetch + triticale mixtures parcels are given in Table 4.3.

Table 4.3. The effect of mixture rate in pure triticale and vetch + triticale mixtures on triticale plant height and the related variance analysis results

Variance Source	Degree of Freedom	Squares Total	Squares Average	F Value
Repetition	2	649.48800	324.744	0.0083
Mixture Ratio	4	217.74933	54.4373	$0.2768^{N.S.}$
Error	8	281.0187	35.1273	
General	14	1148.2560		

F values marked with N.S. are insignificant at 5% ($P \geq 0.05$).

As the table suggests, mixture ratio does not have a statistically significant effect on triticale plant height. The triticale plant height averages detected in pure vetch and different mixtures are given in Table 4.4.

As seen in the table, the triticale plant height has varied between 77.60 cm and 87.73 cm in pure triticale and vetch + triticale mixture ratios. The triticale plant height average in pure triticale and vetch + triticale mixtures in different ratios has been defined as 80.16 cm.

Studies related to common vetch + triticale mixtures in different parts of Turkey have provided different triticale plant height values. For example, the values we have acquired regarding triticale plant height were lower than those acquired by Çil (1998) 112.32 cm, Kılıç (1999) 123.55 cm and Çil (2000) 112.7-120.7 cm; higher than Acar (1995), 18.3-22.6 cm, and similar to Şahin and Babaç (1990), 67.3-99.3 cm. The differences between our findings and those of the other researchers could be attributed to the fact that varieties and mixture ratios used in the trials were different or the climate and soil conditions of the trial zone.

Table 4.4. Plant height (cm) averages detected in triticale found in pure sowing and different vetch + triticale mixtures

Mixture Ratios	**Triticale Plant Height (cm)**
100% Triticale	77.60
80% Vetch + 20% Triticale	78.27
60% Vetch + 40% Triticale	87.73
40% Vetch + 60% Triticale	78.27
20% Vetch + 80% Triticale	78.93
Average	**80.16**

4.3. Green Herbage Yield (kg/da)

The variance analysis results of the green herbage yield values measured at pure sowing and four different vetch + triticale mixtures parcels are given in Table 4.5.

As seen in the table, mixture ratio significantly affects the green herbage yield, statistically at a level of 1%. The green herbage yield averages detected in pure sowing and different mixtures are given in Table 4.6.

Table 4.5. Results of the variance analysis related to the effect of the mixture rate of pure sowing and different vetch + triticale mixtures on the green herbage yield

Variance Source	Degree of Freedom	Squares Total	Squares Average	F Value
Repetition	2	5402.81	2701.405	0.1409
Mixture Ratio	5	184216.22	36843.244	0.0001**
Error	10	11257.63	1125.763	
General	17	200876.67		

** Marked F values are important at 1% (P≤0.01) .

As the table suggests, the highest green herbage yield has been acquired from Pure triticale parcels by 1090.67 kg/da, while the lowest green herbage yield was 769.78 kg/da acquired from mixture parcels containing 60% vetch + 40% triticale. Green herbage yield average of pure sowing and mixtures with different ratios has been defined as 920.56 kg/da.

Table 4.6. Green herbage yield (kg/da) averages detected in pure sowing and different vetch + triticale mixtures

Mixture Ratios	**Green Herbage Yield (kg/da)**
100% Vetch	949.33 BC
100% Triticale	1090.67 A
80% Vetch + 20% Triticale	971.11 B
60% Vetch + 40% Triticale	769.78 E
40% Vetch + 60% Triticale	844.00 D
20% Vetch + 80% Triticale	898.44 CD
Average	**920.56**

Averages indicated with the same name are statistically same according to LSD test, within P≤0.01 error margins.

Studies related to pure sowing and common vetch + triticale mixtures in different parts of Turkey have provided different green herbage yield values. For example, under Samsun ecologic conditions green herbage yield values were 2158 kg/da (Acar 1995) and 1137-2916 kg/da (Albayrak et al., 2004), under the Cukurova ecologic conditions the values were 2892 kg/da (Hasar and Tükel 1994), 3447.6 kg/da (Çil 1998), 3979 kg/da (Kılıç 1999) and 3137 kg/da (Çil 2000), under Tokat ecologic conditions they were 1350.4 kg/da (İptaş and Yılmaz 1996), under Aydın ecologic conditions they were

3791-3952 kg/da (Konak et al. 1997), under Greek ecologic conditions they were 2049-3074 kg/da (Lithourgidis et al. 2006), under Isparta ecologic conditions they were 2123 kg/da (Balabanlı et al, 2010), under Mexican ecologic conditions they were 4000-6500 kg/da (Aguilar-Lopez et al. 2013) and under Bursa ecologic conditions they were 1253-1521 kg/da (Budaklı Çarpıcı and Çelik 2014). The findings we have acquired have been lower than those above.

4.4. Vetch Ratio in Green Herbage (%)

The variance analysis results of the vetch ratio in green herbage values measured at pure common vetch and four different vetch + triticale mixtures parcels are given in Table 4.7.

Table 4.7. Results of the variance analysis related to the effect of the mixture rate of pure vetch and different vetch + triticale mixtures on the vetch rate in green herbage

Variance Source	Degree of Freedom	Squares Total	Squares Average	F Value
Repetition	2	23.016	11.508	0.1743
Mixture Ratio	4	16296.592	4074.148	0.0001**
Error	8	42.017	5.252	
General	14	16361.626		

** Marked F values are important at 1% (P≤0.01).

As seen in the table, mixture ratio significantly affects the, statistically at a level of 1%. The vetch ratio in green herbage averages detected in pure vetch and different mixtures are given in Table 4.8.

As the table suggests, the highest vetch ratio in green herbage has been acquired from pure vetch parcels by 100%, while the lowest vetch ratio in green herbage was taken from mixture parcels containing 20% vetch + 80% triticale, by 6.51%. The vetch ratio in green herbage average in pure vetch and mixtures in different ratios has been defined as 40.39%.

Studies related to common vetch + triticale mixtures in different parts of Turkey have provided different vetch ratio in green herbage values. For example, the values we acquired related to vetch ratio in green herbage were higher than those of Acar (1995) 3.5-4.0%, Kılıç (1999) 7.00-12.10% and Çil (2000) 3.5-6.5%; and similar to those by Çil (1998) 4.5-36.3%.

Table 4.8. Green herbage vetch ratio (%) averages detected in pure vetch and different vetch + triticale mixtures

Mixture Ratios	**Vetch Ratio in Green Herbage (%)**
100% Vetch	100.00 (90.00+) A
80% Vetch + 20% Triticale	47.79 (43.73) B
60% Vetch + 40% Triticale	31.83 (34.34) C
40% Vetch + 60% Triticale	15.84 (23.43) D
20% Vetch + 80% Triticale	6.51 (14.78) E
Average	**40.39** **(41.26)**

Averages indicated with the same name are statistically same according to LSD test, within P≤0.01 error margins.
+Angle value

4.5. Dry Hay Yield (kg/da)

The variance analysis results of the dry hay yield values measured at pure sowing and four different vetch + triticale mixtures parcels are given in Table 4.9.

As seen in the table, mixture ratio significantly affects the dry hay yield, statistically at a level of 1%. The dry hay yield averages detected in pure sowing and different mixtures are given in Table 4.10.

Table 4.9. Results of the variance analysis related to the effect of the mixture rate of pure sowing and different vetch + triticale mixtures on the dry hay yield

Variance Source	Degree of Freedom	Squares Total	Squares Average	F Value
Repetition	2	667.82	333.91	0.7626
Mixture Ratio	5	218836.06	43767.212	0.0001**
Error	10	11988.22	1198.822	
General	17	231492.10		

** Marked F values are important at 1% (P≤0.01).

As the table suggests, highest dry hay yield has been acquired from 20% vetch + 80% triticale parcels by 644.24 kg/da, while the lowest dry hay yield was acquired from pure vetch parcels by 290.83 kg/da. The dry hay yield average of pure sowing and mixtures in different ratios has been defined as 504.75 kg/da.

Table 4.10. Dry hay yield (kg/da) averages detected in pure sowing and different vetch + triticale mixtures

Mixture Ratios	**Dry Hay Yield (kg/da)**
100% Vetch	290.83 E
100% Triticale	490.74 CD
80% Vetch + 20% Triticale	543.78 BC
60% Vetch + 40% Triticale	480.53 D
40% Vetch + 60% Triticale	578.36 B
20% Vetch + 80% Triticale	644.24 A
Average	**504.75**

Averages indicated with the same name are statistically same according to LSD test, within P≤0.01 error margins.

Studies related to pure sowing and common vetch + triticale mixtures in different parts of Turkey have provided different dry hay yield values. For example, under Cukurova ecologic conditions dry hay yield values were 1137-2916 kg/da (Albayrak et al. 2004), under the Cukurova ecologic conditions the values were 846.4 kg/da (Hasar and Tükel 1994), 968.4 kg/da (Çil 1998), 1471 kg/da (Kılıç 1999), 771-1215 kg/da (Çil 2000) and 557-1208 kg/da (Yücel and Avcı 2009), under Tokat ecologic conditions 933-1096 kg/da (Karadağ and Büyükburç 2004), under Greek ecologic conditions 717-1076 kg/da

(Lithourgidis 2006) and under Mexican ecologic conditions 871.0-894.9 kg/da (Aguilar-Lopez et al. 2013). The findings we have acquired have been lower than those above.

On the other hand, the dry hay yield values we acquired from the study were similar to those by Acar (1995) 369.3 kg/da, İptaş and Yılmaz (1996) 368.7 kg/da, Kökten et al. (2003) 313-501 kg/da, Albayrak et al. (2004) 288-610 kg/da, Kökten et al. (2009) 191-436 kg/da, Balabanlı et al. (2010) 691 kg/da, Rakeih et al. (2010) 343 kg/da and Yücel et al. (2014) 468-504 kg/da.

4.6. Vetch Ratio in Dry Hay (%)

The variance analysis results of the dry hay vetch ratio values measured at pure common vetch and four different vetch + triticale mixtures parcels are given in Table 4.11.

Table 4.11. Results of the variance analysis related to the effect of the mixture rate of pure sowing and different vetch + triticale mixtures on the vetch ratio in dry hay

Variance Source	Degree of Freedom	Squares Total	Squares Average	F Value
Repetition	2	4.804	2.402	0.0393
Mixture Ratio	4	14460.284	3615.071	0.0001**
Error	8	3.856	0.482	
General	14	14468.944		

** Marked F values are important at 1% (P≤0.01) .

As seen in the table, mixture ratio significantly affects the vetch ratio in dry hay, statistically at a level of 1%. The vetch ratio in dry hay averages detected in pure vetch and different mixtures are given in Table 4.12.

As the table suggests, highest vetch ratio in dry hay has been acquired from pure vetch parcels by 100%, while the lowest vetch ratio in dry hay was acquired from mixture parcels containing 20% vetch + 80% triticale by 11.01%. The vetch ratio in dry hay average of pure vetch and mixtures in different ratios has been defined as 42.76%.

Studies related to common vetch + triticale mixtures in different parts of Turkey have provided different vetch ratio in dry hay values. For example, the values we acquired related to vetch ratio in dry hay were higher than those of Acar (1995) 5.8-6.0%, Kılıç (1999) 6.5-10.3% and Çil (2000) 3.0-5.5%; lower than those of Albayrak et al. (2004) 47.5-74.6% and similar to those of Çil (1998) 4.5-34.2%, Kökten et al. (2003) 31.5-78.3%, Kökten et al. (2009) 7.5-37.3% and Yücel and Avcı (2009) %3.3-32.1.

Table 4.12. The dry hay vetch ratio (%) averages detected in pure sowing and different vetch + triticale mixtures.

Mixture Ratios	**Vetch Ratio in Dry Hay (%)**
100% Vetch	100.00 (90.00^{+}) A
80% Vetch + 20% Triticale	47.03 (43.30) B
60% Vetch + 40% Triticale	34.03 (35.68) C
40% Vetch + 60% Triticale	21.75 (27.79) D
20% Vetch + 80% Triticale	11.01 (19.38) E
Average	**42.76 (43.23)**

Averages indicated with the same name are statistically same according to LSD test, within P≤0.01 error margins.
+Angle value

4.7. Relative Yield Total

Results of the variance analysis related to the effect of the mixture rate of pure sowing and four different vetch + triticale mixtures on the relative yield total have been provided in Table 4.13.

As the table suggests, mixture ratio affects the relative yield total at a statistically important level of 1%. The relative yield total averages detected in pure sowing and different mixtures have been provided in Table 4.14.

Table 4.13. Results of the variance analysis related to the effect of the mixture rate of pure sowing and different vetch + triticale mixtures on the relative yield total

Variance Source	Degree of Freedom	Squares Total	Squares Average	F Value
Repetition	2	0.11298349	0.056491745	0.0097
Mixture Ratio	5	0.46911261	0.093822522	0.0005**
Error	10	0.07393903	0.007393903	
General	17	0.65603513		

** Marked F values are important at 1% (P≤0.01) .

Looking at the table, the highest relative yield total has been acquired from 80% vetch + 20% triticale parcels by 1.40, this has been followed by 20% vetch + 80% triticale (1.36) and 40% vetch + 60% triticale (1.28) parcels, statistically found in the same group. Then the lowest relative yield total of 1.00 has been acquired from the pure sowing parcels. The relative yield total average of pure sowing and mixtures in different ratios has been defined as 1.20.

Table 4.14. The relative yield total averages detected in pure sowing and different vetch + triticale mixtures

Mixture Ratios	**Relative yield total**
100% Vetch	1.00 C
100% Triticale	1.00 C
80% Vetch + 20% Triticale	1.40 A
60% Vetch + 40% Triticale	1.15 BC
40% Vetch + 60% Triticale	1.28 AB
20% Vetch + 80% Triticale	1.36 A
Average	**1.20**

Averages indicated with the same name are statistically same according to LSD test, within P≤0.01 error margins.

Studies related to common vetch + triticale mixtures in different parts of Turkey have provided different relative yield total values. For example, the values we acquired related to relative yield total were lower than those of Albayrak et al. (2004) 1.45-1.76 and Karadağ and Büyükburç (2004) 1.61-1.76, and higher than those of Lithourgidis et al. (2006) 0.87-1.00 and Lithourgidis et al. (2007) 0.92-1.00 and similar to those of

Kökten et al. (2003) 0.74-1.62, Kökten et al. (2009) 0.89-1.20, Rakeih et al. (2010) 1.00-1.05 and Şahin and Babaç (1990) 0.98-1.21.

4.8. Crude Protein Ratio (%)

The variance analysis results of the crude protein ratio values measured at pure sowing and four different vetch + triticale mixtures parcels are given in Table 4.15.

As seen in the table, mixture ratio significantly affects the crude protein ratios, statistically at a level of 1%. The crude protein ratio averages detected in pure sowing and different mixtures are given in Table 4.16.

Table 4.15. Results of the variance analysis related to the effect of the mixture rate of pure sowing and different vetch + triticale mixtures on the crude protein ratio.

Variance Source	Degree of Freedom	Squares Total	Squares Average	F Value
Repetition	2	0.56350	0.28175	0.3287
Mixture Ratio	5	510.05686	102.011372	0.0001**
Error	10	2.26134	0.226134	
General	17	512.88170		

** Marked F values are important at 1% (P≤0.01).

As the table suggests, highest crude protein ratio has been acquired from pure vetch parcels by 21.20%, while the lowest crude protein ratio was acquired from pure triticale parcels by 6.14%. The crude protein ratio average of pure sowing and mixtures in different ratios has been defined as 13.15%.

Studies related to pure sowing and common vetch + triticale mixtures in different parts of Turkey have provided different crude protein ratio values. For example, under Samsun ecologic conditions crude protein ratio has been defined as 9.76-18.49% (Acar 1995) and 10.4-19.1% (Albayrak et al. 2004) and 8.99-18.20% (Karadağ and Büyükburç 2004), under Aydın ecologic conditions as 10.86-11.43% (Konak et al. 1997), under Cukurova ecologic conditions as 8.9-22.5% (Çil 1998), 4.9-19.4% (Kılıç 1999), 5.4-19.3% (Kökten et al. 2009) and 7.76-18.03% (Yücel and Avcı 2009), under

Greek ecologic conditions as 6.30-13.09% (Lithourgidis et al. 2006), under Isparta ecologic conditions as 13.7-16.1% (Türk et al., 2007) and 12.8% (Balabanlı et al. 2010), and under Bursa ecologic conditions as 6.9-21.0% (Budaklı Çarpıcı and Çelik 2014). The findings we have acquired have been similar to those above.

Table 4.16. The crude protein ratio (%) averages detected in pure sowing and different vetch + triticale mixtures.

Mixture Ratios	**Crude Protein Ratio (%)**
100% Vetch	21.20 A
100% Triticale	6.14 F
80% Vetch + 20% Triticale	18.11 B
60% Vetch + 40% Triticale	13.93 C
40% Vetch + 60% Triticale	11.71 D
20% Vetch + 80% Triticale	7.79 E
Average	**13.15**

Averages indicated with the same name are statistically same according to LSD test, within P≤0.01 error margins.

4.9. Crude Protein Yield (kg/da)

The variance analysis results of the crude protein yield values measured at pure sowing and four different vetch + triticale mixtures parcels are given in Table 4.17.

As seen in the table, mixture ratio significantly affects the crude protein yield, statistically at a level of 1%. The crude protein yield averages detected in pure sowing and different mixtures are given in Table 4.18.

As the table suggests, highest crude protein yield has been acquired from 80% vetch + 20% triticale parcels by 98.46 kg/da, while the lowest crude protein yield was acquired from pure triticale parcels by 29.97 kg/da. The crude protein yield average of pure sowing and mixtures in different ratios has been defined as 62.49 kg/da.

Table 4.17. Results of the variance analysis related to the effect of the mixture rate of pure sowing and different vetch + triticale mixtures on the crude protein yield

Variance Source	Degree of Freedom	Squares Total	Squares Average	F Value
Repetition	2	30.7671	15.38355	0.6023
Mixture Ratio	5	7656.7295	1531.3459	0.0001**
Error	10	288.2589	28.82589	
General	17	7975.3055		

** Marked F values are important at 1% (P≤0.01).

Table 4.18. The crude protein yield (kg/da) averages detected in pure sowing and different vetch + triticale mixtures

Mixture Ratios	**Crude Protein Yield (kg/da)**
100% Vetch	61.56 B
100% Triticale	29.97 D
80% Vetch + 20% Triticale	98.46 A
60% Vetch + 40% Triticale	66.97 B
40% Vetch + 60% Triticale	67.78 B
20% Vetch + 80% Triticale	50.17 C
Average	**62.49**

Averages indicated with the same name are statistically same according to LSD test, within P≤0.01 error margins.

Studies related to pure sowing and common vetch + triticale mixtures in different parts of Turkey have provided different crude protein yield values. For example, under Samsun ecologic conditions crude protein yield has been defined as 61.09 kg/da (Acar 1995) and 30-91 kg/da (Albayrak et al. 2004), under Cukurova ecologic conditions as 97.58 kg/da (Hasar and Tükel 1994), 78.78-110.60 kg/da (Çil 1998), 16.54-120.63 kg/da (Kılıç 1999), 48.3-60.8 kg/da (Kökten et al. 2003) and 29-66 kg/da (Kökten et al. 2009), under Tokat ecologic conditions as 58.2 kg/da (İptaş and Yılmaz 1996) and 94-105 kg/da (Karadağ and Büyükburç 2004) and under Isparta ecologic conditions as 83 kg/da (Balabanlı et al. 2010). The findings we have acquired have been similar to those above.

On the other hand, the crude protein yield values we acquired from the study were lower than those by Çil (2000) 138.4-228.5 kg/da and Yücel and Avcı (2009) 94.3-133.9 kg/da.

4.10. Crude Ash Ratio (%)

The variance analysis results of the crude ash ratio values measured at pure sowing and four different vetch + triticale mixtures parcels are given in Table 4.19.

As seen in the table, mixture ratio significantly affects the crude ash ratio, statistically at a level of 1%. The crude ash ratio averages detected in pure sowing and different mixtures are given in Table 4.20.

Table 4.19. Results of the variance analysis related to the effect of the mixture rate of pure sowing and different vetch + triticale mixtures on the crude ash ratio

Variance Source	Degree of Freedom	Squares Total	Squares Average	F Value
Repetition	2	0.270654	0.135327	0.3528
Mixture Ratio	5	45.890093	9.1780186	0.0001**
Error	10	1.168129	0.1168129	
General	17	47.328875		

** Marked F values are important at 1% (P≤0.01).

As the table suggests, highest crude ash ratio has been acquired from 80% vetch + 20% triticale parcels by 9.73%, and this was followed by pure vetch (9.31%) parcels, statistically in the same group. Then the lowest crude ash ratio was acquired from pure triticale parcels by 5.75% and the ratio followed by 20% vetch + 80% triticale parcels by 5.97% statistically in the same group. The crude ash ratio average of pure sowing and mixtures in different ratios has been defined as 7.70%.

Studies related to common vetch + triticale mixtures in different parts of Turkey have provided different crude ash ratio values. For example, the crude ash ratio values we have acquired are lower than those of Karadağ and Büyükburç (2004), 9.82-13.52% and Yücel et al. (2014), 10.0-10.1%; but similar to Eğritaş and Önal Aşçı (2015), 4.7-9.1%.

Table 4.20. The crude ash ratio averages detected in pure sowing and different vetch + triticale mixtures

Mixture Ratios	**Crude Ash Ratio (%)**
100% Vetch	9.31 A
100% Triticale	5.75 D
80% Vetch + 20% Triticale	9.73 A
60% Vetch + 40% Triticale	8.65 B
40% Vetch + 60% Triticale	6.78 C
20% Vetch + 80% Triticale	5.97 D
Average	**7.70**

Averages indicated with the same name are statistically same according to LSD test, within P≤0.01 error margins.

4.11. Acid Detergent Fibre (ADF) Ratio (%)

The variance analysis results of the ADF ratio values measured at pure sowing and four different vetch + triticale mixtures parcels are given in Table 4.21.

Table 4.21. Results of the variance analysis related to the effect of the mixture rate of pure sowing and different vetch + triticale mixtures on the ADF ratio

Variance Source	Degree of Freedom	Squares Total	Squares Average	F Value
Repetition	2	0.26481	0.132405	0.7506
Mixture Ratio	5	259.63904	51.927808	0.0001**
Error	10	4.48490	0.44849	
General	17	264.38875		

** Marked F values are important at 1% (P≤0.01) .

As seen in the table, mixture ratio significantly affects the ADF ratio, statistically at a level of 1%. The ADF ratio averages detected in pure sowing and different mixtures are given in Table 4.22.

As the table suggests, highest ADF ratio has been acquired from 20% vetch + 80% triticale parcels by 42.21%, while the lowest ADF ratio was acquired from 40% vetch + 60% triticale parcels by 31.20%. The ADF ratio average of pure sowing and mixtures in different ratios has been defined as 35.09%.

Table 4.22. The ADF ratio (%) averages detected in pure sowing and different vetch + triticale mixtures

Mixture Ratios	**ADF Ratio (%)**
100% Vetch	37.85 B
100% Triticale	33.67 C
80% Vetch + 20% Triticale	33.44 C
60% Vetch + 40% Triticale	32.19 D
40% Vetch + 60% Triticale	31.20 D
20% Vetch + 80% Triticale	42.21 A
Average	**35.09**

Averages indicated with the same name are statistically same according to LSD test, within P≤0.01 error margins.

Studies related to common vetch + triticale mixtures in different parts of Turkey have provided different ADF ratio values. For example, the values we acquired related to ADF ratio were higher than those of Lithourgidis et al. (2007) 29.3-31.9%, and lower than those of Yücel and Avcı (2009), 40.11-44.72%; but similar to Lithourgidis et al. (2006) 36.0-38.1%, Balabanlı et al. (2010) 35.14%, Aguilar-Lopez (2013) 31.6-37.7%, Budaklı Çarpıcı and Çelik (2014) 32.0-42.2% and Yücel et al. (2014) 31.0-32.8%. Acar (1995) 5.8-6.0%, Kılıç (1999) 6.5-10.3% and Çil (2000) 3.0-5.5%; lower than those of Albayrak et al. (2004) 47.5-74.6% and similar to those of Çil (1998) 4.5-34.2%, Kökten et al. (2003) 31.5-78.3%, Kökten et al. (2009) 7.5-37.3% and Yücel and Avcı (2009) %3.3-32.1.

4.12. Neutral Detergent Fibre (NDF) Ratio (%)

The variance analysis results of the NDF ratio values measured at pure sowing and four different vetch + triticale mixtures parcels are given in Table 4.23.

As seen in the table, mixture ratio significantly affects the NDF ratios, statistically at a level of 1%. The NDF ratio averages detected in pure sowing and different mixtures are given in Table 4.24.

As the table suggests, highest NDF ratio has been acquired from 20% vetch + 80% triticale parcels by 66.44%, while the lowest NDF ratio was acquired from 60% vetch +

40% triticale parcels by 51.99%. The NDF ratio average of pure sowing and mixtures in different ratios has been defined as 57.30%.

Table 4.23. Results of the variance analysis related to the effect of the mixture rate of pure sowing and different vetch + triticale mixtures on the NDF ratio

Variance Source	Degree of Freedom	Squares Total	Squares Average	F Value
Repetition	2	0.14142	0.07071	0.8226
Mixture Ratio	5	531.19184	106.238368	0.0001**
Error	10	3.55013	0.355013	
General	17	534.88339		

** Marked F values are important at 1% (P≤0.01) .

Table 4.24. NDF ratio (%) averages detected in pure sowing and different vetch + triticale mixtures

Mixture Ratios	**NDF Ratio (%)**
100% Vetch	52.01 E
100% Triticale	62.53 B
80% Vetch + 20% Triticale	54.23 D
60% Vetch + 40% Triticale	51.99 E
40% Vetch + 60% Triticale	56.61 C
20% Vetch + 80% Triticale	66.44 A
Average	**57.30**

Averages indicated with the same name are statistically same according to LSD test, within P≤0.01 error margins.

Studies related to common vetch + triticale mixtures in different parts of Turkey have provided different NDF ratio values. For example, the values we acquired related to NDF ratio were higher than those of Lithourgidis et al. (2006) 35.8-45.69%, Lithourgidis et al. (2007) 41.4-43.0% and Yücel et al. (2014) 38.6-42.9%; but similar to Yücel and Avcı (2009), 46.6-66.4%, Balabanlı et al. (2010) 53.97%, Aguilar-Lopez (2013) 56.1-57.8% and Budaklı Çarpıcı and Çelik (2014) 55.0-65.5%.

4.13. Dry Matter Digestibility (DMD) Ratio (%)

The variance analysis results of the DMD ratio values measured at pure sowing and four different vetch + triticale mixtures parcels are given in Table 4.25.

As seen in the table, mixture ratio significantly affects the DMD ratio, statistically at a level of 1%. The DMD ratio averages detected in pure sowing and different mixtures are given in Table 4.26.

Table 4.25. Results of the variance analysis related to the effect of the mixture rate of pure sowing and different vetch + triticale mixtures on the SKM ratio

Variance Source	Degree of Freedom	Squares Total	Squares Average	F Value
Repetition	2	0.16070	0.08035	0.7506
Mixture Ratio	5	157.55962	31.511924	0.0001**
Error	10	2.72162	0.272162	
General	17	160.44194		

** Marked F values are important at 1% (P≤0.01) .

Table 4.26. The DMD ratio (%) averages detected in pure sowing and different vetch + triticale mixtures

Mixture Ratios	**DMD Ratio (%)**
100% Vetch	59.42 C
100% Triticale	62.67 B
80% Vetch + 20% Triticale	62.85 B
60% Vetch + 40% Triticale	63.82 A
40% Vetch + 60% Triticale	64.59 A
20% Vetch + 80% Triticale	56.02 D
Average	**61.56**

Averages indicated with the same name are statistically same according to LSD test, within P≤0.01 error margins.

As the table suggests, highest DMD ratio has been acquired from 40% vetch + 60% triticale parcels by 64.59% and this followed by 60% vetch + 40% triticale parcels (63.82%), statistically in the same group. Then the lowest DMD ratio was acquired from 20% vetch + 80% triticale parcels by 56.02%. The DMD ratio average of pure sowing and mixtures in different ratios has been defined as 61.56%.

Studies related to common vetch + triticale mixtures in different parts of Turkey have provided different DMD ratio values. For example, under Greek ecologic conditions DMD ratio was defined as 59.2-60.8% (Lithourgidis et al. 2006) and under Cukurova ecologic conditions it was defined as 53.8-57.6% (Yücel and Avcı 2009). The values we have acquired from the study had similarities to those above.

4.14. Dry Matter Intake (DMI) Ratio (%)

The variance analysis results of the DMI ratio values measured at pure sowing and four different vetch + triticale mixtures parcels are given in Table 4.27.

As seen in the table, mixture ratio significantly affects the DMI ratio, statistically at a level of 1%. The DMI ratio averages detected in pure sowing and different mixtures are given in Table 4.28.

Table 4.27. Results of the variance analysis related to the effect of the mixture rate of pure sowing and different vetch + triticale mixtures on the DMI ratio

Variance Source	Degree of Freedom	Squares Total	Squares Average	F Value
Repetition	2	0.00014680	0.0000734	0.8506
Mixture Ratio	5	0.65297054	0.130594108	0.0001**
Error	10	0.00446329	0.000446329	
General	17	0.65758063		

** Marked F values are important at 1% (P≤0.01).

As the table suggests, highest DMI ratio has been acquired from 60% Vetch + 40% Triticale and pure vetch parcels by 2.31%, while the lowest DMI ratio was acquired from 20% Vetch + 80% Triticale parcels by 1.81%. The DMI ratio average of pure sowing and mixtures in different ratios has been defined as 2.11%.

Table 4.28. The DMI ratio (%) averages detected in pure sowing and different vetch + triticale mixtures

Mixture Ratios	**DMI Ratio (%)**
100% Vetch	2.31 A
100% Triticale	1.92 D
80% Vetch + 20% Triticale	2.21 B
60% Vetch + 40% Triticale	2.31 A
40% Vetch + 60% Triticale	2.12 C
20% Vetch + 80% Triticale	1.81 E
Average	**2.11**

Averages indicated with the same name are statistically same according to LSD test, within P≤ 0.01 error margins.

Studies related to common vetch + triticale mixtures in different parts of Turkey have provided different DMI ratio values. For example, the values we acquired related to DMI ratio were lower than those of Lithourgidis et al. (2006) 2.63-3.35% and similar to those Yücel and Avcı (2009) 1.81-2.58%.

4.15. Relative Feed Value (RFV)

The variance analysis results of the RFV values measured at pure sowing and four different vetch + triticale mixtures parcels are given in Table 4.29.

As seen in the table, mixture ratio significantly affects the RFV value, statistically at a level of 1%. The RFV value averages detected in pure sowing and different mixtures are given in Table 4.30.

Table 4.29. Results of the variance analysis related to the effect of the mixture rate of pure sowing and different vetch + triticale mixtures on the RFV value

Variance Source	Degree of Freedom	Squares Total	Squares Average	F Value
Repetition	2	0.8018	0.4009	0.8619
Mixture Ratio	5	2534.2683	506.85366	0.0001**
Error	10	26.5871	2.65871	
General	17	2561.6572		

** Marked F values are important at 1% (P≤0.01).

As the table suggests, highest RFV value has been acquired from 60% vetch + 40% triticale parcels by 114.21, while the lowest RFV value was acquired from 20% vetch + 80% triticale parcels by 78.43. The RFV value average of pure sowing and mixtures in different ratios has been defined as 101.02%.

Studies related to common vetch + triticale mixtures in different parts of Turkey have provided different RFV values. For example, under Greek ecologic conditions RFV ratio was defined as 120.72-157.97 (Lithourgidis et al. 2006). The values we have acquired from the study were lower than those above.

Table 4.30. The RFV value averages detected in pure sowing and different vetch + triticale mixtures

Mixture Ratios	**RFV**
100% Vetch	106.26 B
100% Triticale	93.25 C
80% Vetch + 20% Triticale	107.82 B
60% Vetch + 40% Triticale	114.21 A
40% Vetch + 60% Triticale	106.15 B
20% Vetch + 80% Triticale	78.43 D
Average	**101.02**

Averages indicated with the same name are statistically same according to LSD test, within P≤0.01 error margins.

4.16. P (Phosphor) Ratio (%)

The variance analysis results of the phosphor ratio values measured at pure sowing and four different vetch + triticale mixtures parcels are given in Table 4.31.

As the table suggests, mixture ratio did not have any statistically significant effects on phosphor ratios. The P ratio average of pure sowing and mixtures in different ratios has been given in Table 4.32.

Table 4.31. Results of the variance analysis related to the effect of the mixture rate of pure sowing and different vetch + triticale mixtures on the P ratio

Variance Source	Degree of Freedom	Squares Total	Squares Average	F Value
Repetition	2	0.00513644	0.00256822	0.2195
Mixture Ratio	5	0.00738511	0.001477022	$0.4558^{N.S.}$
Error	10	0.01449556	0.001449556	
General	17	0.02701711		

** F values marked with N.S. are insignificant at 5% ($P \geq 0.05$).

As the table suggests, P ratio has ranged between 0.107% and 0.167% in vetch + triticale mixture ratios. The P ratio average of pure sowing and mixtures in different ratios has been defined as 0.135%.

Table 4.32. The P ratio (%) averages detected in pure sowing and different vetch + triticale mixtures

Mixture Ratios	**P Ratio (%)**
100% Vetch	0.107
100% Triticale	0.123
80% Vetch + 20% Triticale	0.121
60% Vetch + 40% Triticale	0.151
40% Vetch + 60% Triticale	0.143
20% Vetch + 80% Triticale	0.167
Average	**0.135**

In order to meet the macro nutrition element need of animals at a minimum level, fodders need to contain P at a 0.2% ratio (Anonym 1971). Studies related to common vetch + triticale mixtures in different parts of Turkey have provided different P ratio values. For example, under Erzurum ecologic conditions P ratio was defined as 0.350% (Tan and Serin 1996), 0.194-0.216% under Van ecologic conditions (Karaca and Çimrin 2002) and 0.55-0.77% (Çelen et al. 2005), 0.170-0.220% (Türk et al. 2007) under Isparta ecologic conditions, 0.09% under Iranian conditions (Badrzadeh et al. 2008), 0.320-0.340% (Yücel et al. 2014) under Cukurova ecologic conditions and 0.290-0.610% under Ordu ecologic conditions (Eğritaş and Önal Aşçı 2015).

4.17. K (Potassium) Ratio (%)

The variance analysis results of the potassium ratio values measured at pure sowing and four different vetch + triticale mixtures parcels are given in Table 4.33.

Table 4.33. Results of the variance analysis related to the effect of the mixture rate of pure sowing and different vetch + triticale mixtures on the K ratio

Variance Source	Degree of Freedom	Squares Total	Squares Average	F Value
Repetition	2	0.00669292	0.0033464	0.8268
Mixture Ratio	5	0.07723422	0.015446844	$0.5199^{N.S}$
Error	10	0.17260724	0.017260724	
General	17	0.25653438		

F values marked with N.S. are insignificant at 5% ($P \geq 0.05$).

As the table suggests, mixture ratio did not have any statistically significant effects on potassium ratios. The K ratio average of pure sowing and mixtures in different ratios has been given in Table 4.34.

As the table suggests, K ratio has ranged between 0.642% and 0.864%in vetch + triticale mixture ratios. The K ratio average of pure sowing and mixtures in different ratios has been defined as 0.745%.

Table 4.34. The K ratio (%) averages detected in pure sowing and different vetch + triticale mixtures

Mixture Ratios	**K Ratio (%)**
100% Vetch	0.743
100% Triticale	0.719
80% Vetch + 20% Triticale	0.759
60% Vetch + 40% Triticale	0.864
40% Vetch + 60% Triticale	0.741
20% Vetch + 80% Triticale	0.642
Average	**0.745**

In order to meet the macro nutrition element need of animals at a minimum level, fodders need to contain K at a 0.8% ratio (Anonym 1971). Studies related to common

vetch + triticale mixtures in different parts of Turkey have provided different K ratio values. For example, under Erzurum ecologic conditions K ratio was defined as 3.54% (Tan and Serin 1996), 01.632-1.731% (Karaca and Çimrin 2002) and 1.29-2.07% (Çelen et al. 2005) under Van ecologic conditions, 1.20-1.88% (Türk et al. 2007) under Isparta ecologic conditions, 1.35% under Iranian conditions (Badrzadeh et al. 2008), 3.69-3.96% (Yücel et al. 2014) under Cukurova ecologic conditions and 0.48-1.44% under Ordu ecologic conditions (Eğritaş and Önal Aşçı 2015).

4.18. Ca (Calcium) Ratio (%)

The variance analysis results of the calcium ratio values measured at pure sowing and four different vetch + triticale mixtures parcels are given in Table 4.35.

As the table suggests, mixture ratio did not have any statistically significant effects on calcium ratios. The Ca ratio averages of pure sowing and mixtures in different ratios have been given in Table 4.36.

Table 4.35. Results of the variance analysis related to the effect of the mixture rate of pure sowing and different vetch + triticale mixtures on the Ca ratio

Variance Source	Degree of Freedom	Squares Total	Squares Average	F Value
Repetition	2	0.12781075	0.063905373	0.6598
Mixture Ratio	5	0.41272700	0.00825454	0.7288$^{N.S.}$
Error	10	1.4738880	0.14738880	
General	17	2.0144258		

F values marked with N.S. are insignificant at 5% ($P \geq 0.05$).

As the table suggests, Ca ratio has ranged between 0.68% and 1.14%in vetch + triticale mixture ratios. The Ca ratio average of pure sowing and mixtures in different ratios has been defined as 0.99%.

Table 4.36. The Ca ratio (%) averages detected in pure sowing and different vetch + triticale mixtures

Mixture Ratios	**Ca Ratio (%)**
100% Vetch	1.06
100% Triticale	0.92
80% Vetch + 20% Triticale	1.03
60% Vetch + 40% Triticale	1.14
40% Vetch + 60% Triticale	1.08
20% Vetch + 80% Triticale	0.68
Average	**0.99**

In order to meet the Ca need of animals at a minimum level, fodders need to contain Ca at a 0.3% ratio (Anonym 1971). Studies related to common vetch + triticale mixtures in different parts of Turkey have provided different Ca ratio values. For example, under Erzurum ecologic conditions Ca ratio was defined as 0.35% (Tan and Serin 1996), 0.854-0.902% (Karaca and Çimrin 2002) and 3.78-6.78% (Çelen et al. 2005) under Van ecologic conditions, 1.43-2.24% (Türk et al. 2007) under Isparta ecologic conditions, 1.38% under Iranian conditions (Badrzadeh et al. 2008), 0.91-0.92% (Yücel et al. 2014) under Cukurova ecologic conditions and 0.39-4.45% under Ordu ecologic conditions (Eğritaş and Önal Aşçı 2015).

4.19. Mg (Magnesium) Ratio (%)

The variance analysis results of the magnesium ratio values measured at pure sowing and four different vetch + triticale mixtures parcels are given in Table 4.37.

Table 4.37. Results of the variance analysis related to the effect of the mixture rate of pure sowing and different vetch + triticale mixtures on the Mg ratio

Variance Source	Degree of Freedom	Squares Total	Squares Average	F Value
Repetition	2	0.000251149	0.0001255745	0.5178
Mixture Ratio	5	0.03514257	0.007028514	0.0311*
Error	10	0.01784980	0.001784980	
General	17	0.05550386		

F values marked with * are significant at 5% (P≤0.05).

As the table suggests, mixture ratio did have a statistically significant effect on Mg ratios, at a level of 5%. The Mg ratio averages of pure sowing and mixtures in different ratios have been given in Table 4.38.

As seen in the table, the highest Mg ratio was acquired from 60% vetch + 40% triticale parcels by 0.322%, and it was followed by 80% vetch + 20% triticale (0.317%), pure vetch (0.270%) and 40% vetch + 60% triticale (0.257%) parcels from the same statistically same group. Then the lowest Mg ratio has been acquired from pure triticale parcels by 0.205% and 20% vetch + 80% triticale by 0.220%. The Mg ratio average of pure sowing and mixtures in different ratios has been defined as 0.265%.

In order to meet the magnesium need of ruminants, fodders need to contain Mg at a 0.1% ratio (Anonym 1971). Studies related to common vetch + triticale mixtures in different parts of Turkey have provided different Mg ratio values. For example, under Erzurum ecologic conditions Mg ratio was defined as 0.35% (Tan and Serin 1996), 0.343-0.352% (Karaca and Çimrin 2002) and 0.38-0.60% (Çelen et al. 2005) under Van ecologic conditions, 0.25-0.44% (Türk et al. 2007) under Isparta ecologic conditions, 0.21-0.22% (Yücel et al. 2014) under Cukurova ecologic conditions and 0.14-0.51% under Ordu ecologic conditions (Eğritaş and Önal Aşçı 2015).

Table 4.38. The Mg ratio (%) averages detected in pure sowing and different vetch + triticale mixtures

Mixture Ratios	**Mg Ratio (%)**
100% Vetch	0.270 AB
100% Triticale	0.205 B
80% Vetch + 20% Triticale	0.317 A
60% Vetch + 40% Triticale	0.322 A
40% Vetch + 60% Triticale	0.257 AB
20% Vetch + 80% Triticale	0.220 B
Average	**0.265**

The averages indicated with the same letter are statistically the same within P≤0.05 error margins and according to the LSD test.

4.20. Na (Sodium) Ratio (%)

The variance analysis results of the sodium ratio values measured at pure sowing and four different vetch + triticale mixtures parcels are given in Table 4.39.

Table 4.39. Results of the variance analysis related to the effect of the mixture rate of pure sowing and different vetch + triticale mixtures on the Na ratio

Variance Source	Degree of Freedom	Squares Total	Squares Average	F Value
Repetition	2	0.00065169	0.000325845	0.2595
Mixture Ratio	5	0.00112367	0.000224734	$0.4326^{N.S.}$
Error	10	0.00210425	0.000210425	
General	17	0.00387962		

F values marked with N.S. are insignificant at 5% ($P \geq 0.05$).

As the table suggests, mixture ratio did not have any statistically significant effects on sodium ratios. The Na ratio average of pure sowing and mixtures in different ratios has been given in Table 4.40

As the table suggests, Na ratio has ranged between 0.007% and 0.032% in vetch + triticale mixture ratios. The Na ratio average of pure sowing and mixtures in different ratios has been defined as 0.018%.

Table 4.40. The Na ratio (%) averages detected in pure sowing and different vetch + triticale mixtures

Mixture Ratios	**Na Ratio (%)**
100% Vetch	0.021
100% Triticale	0.007
80% Vetch + 20% Triticale	0.016
60% Vetch + 40% Triticale	0.019
40% Vetch + 60% Triticale	0.011
20% Vetch + 80% Triticale	0.032
Average	**0.018**

In order to meet the Na need of animals at a minimum level, fodders need to contain Na at a 0.2% ratio (Anonym 1971).

5. CONCLUSION AND RECOMMANDATION

This study has been conducted under the ecologic conditions of Genç/Bingöl to determine the effect of common vetch (*Vicia sativa* L.) and triticale (X *Triticosecale* Wittmack.) mixture rates on hay yield and quality and the conclusions and suggestions related to the findings of the study have been given below. The plant materials used in the study were Görkem common vetch variety provided by Dicle University Faculty of Agriculture Department of Field Crops and Tacettin Bey triticale variety provided GAP International Agricultural Research and Training Centre. The research was established as a randomized complete block experimental design with three replications. The study has analysed various characteristics such as common vetch stem length, triticale plant height, green herbage yield, vetch ratio in green herbage, dry hay yield, vetch ratio in dry hay, relative yield total, crude protein ratio, crude protein yield, crude ash ratio, acid detergent fiber, neutral detergent fiber, dry matter digestibility, dry matter intake, relative food value, calcium, magnesium, phosphor, potassium and sodium.

The conclusions of the study have been listed below.

1. It has been observed that the mixture ratio didn't affect the common vetch stem length in a statistically significant level and vetch stem length has ranged between 56.40 cm and 61.23 cm in pure vetch and vetch + triticale mixture ratios. The common vetch stem length average in pure vetch and vetch + triticale mixtures in different ratios has been defined as 58.55 cm.

2. It has been observed that the mixture ratio didn't affect the triticale plant height in a statistically significant level and triticale plant height has ranged between 77.60 cm and 87.73 cm in pure vetch and vetch + triticale mixture ratios. The common triticale plant height average in pure vetch and vetch + triticale mixtures in different ratios has been defined as 80.16 cm.

3. It has been observed that the mixture ratio significantly affects the green herbage yield, statistically at a level of 1%, the highest green herbage yield has been acquired from pure triticale parcels by 1090.67 kg/da, while the lowest green herbage yield was 769.78 kg/da acquired from mixture parcels containing 60% vetch + 40% triticale. Green herbage yield average of pure sowing and mixtures with different ratios has been defined as 920.56 kg/da.

4. It has been observed that the mixture ratio significantly affects the vetch ratio in green herbage, statistically at a level of 1%, the highest vetch ratio in green herbage has been acquired from pure vetch parcels by 90%, while the lowest vetch ratio in green herbage was taken from mixture parcels containing 20% vetch + 80% triticale, by 14.78%. The vetch ratio in green herbage average in pure vetch and mixtures in different ratios has been defined as 41.26%.

5. It has been observed that the mixture ratio significantly affects the dry hay yield, statistically at a level of 1%, highest dry hay yield has been acquired from 20% vetch + 80% triticale parcels by 644.24 kg/da, while the lowest dry hay yield was acquired from pure vetch parcels by 290.83 kg/da. The dry hay yield average of pure sowing and mixtures in different ratios has been defined as 504.75 kg/da.

6. It has been observed that the mixture ratio significantly affects the vetch ratio in dry hay, statistically at a level of 1%, highest vetch ratio in dry hay has been acquired from pure vetch parcels by 90%, while the lowest vetch ratio in dry hay was acquired from mixture parcels containing 20% vetch + 80% triticale by 19.38%. The vetch ratio in dry hay average of pure vetch and mixtures in different ratios has been defined as 43.23%.

7. It has been observed that the mixture ratio significantly affects the relative yield total, statistically at a level of 1%, highest relative yield total has been acquired from 80% vetch + 20% triticale parcels by 1.40, this has been followed by 20% vetch + 80% triticale (1.36) and 40% vetch + 60% triticale (1.28) parcels, statistically found in the same group. Then the lowest relative yield total of 1.00 has been acquired from the pure

sowing parcels. The relative yield total average of pure sowing and mixtures in different ratios has been defined as 1.20.

8. It has been observed that the mixture ratio significantly affects the crude protein ratio, statistically at a level of 1%, highest crude protein ratio has been acquired from pure vetch parcels by 21.20%, while the lowest crude protein ratio was acquired from pure triticale parcels by 6.14%. The crude protein ratio average of pure sowing and mixtures in different ratios has been defined as 13.15%.

9. It has been observed that the mixture ratio significantly affects the crude protein yield, statistically at a level of 1%, highest crude protein yield has been acquired from 80% vetch + 20% triticale parcels by 98.46 kg/da, while the lowest crude protein yield was acquired from pure triticale parcels by 29.97 kg/da. The crude protein yield average of pure sowing and mixtures in different ratios has been defined as 62.49 kg/da.

10. It has been observed that the mixture ratio significantly affects the crude ash ratio, statistically at a level of 1%, highest crude ash ratio has been acquired from 80% Vetch + 20% triticale parcels by 9.73%, and this was followed by pure vetch (9.31%) parcels, statistically in the same group. Then the lowest crude ash ratio was acquired from pure triticale parcels by 5.75% and 20% vetch + 80% triticale by 5.97%. The crude ash ratio average of pure sowing and mixtures in different ratios has been defined as 7.70%.

11. It has been observed that the mixture ratio significantly affects the ADF ratio, statistically at a level of 1%, highest ADF ratio has been acquired from 20% vetch + 80% triticale parcels by 42.21%, while the lowest ADF ratio was acquired from 40% vetch + 60% triticale parcels by 31.20% and 60% vetch + 40% triticale parcels by 32.19%. The ADF ratio average of pure sowing and mixtures in different ratios has been defined as 35.09%.

12. It has been observed that the mixture ratio significantly affects the NDF ratio, statistically at a level of 1%, highest NDF ratio has been acquired from 20% vetch + 80% triticale parcels by 66.44%, while the lowest NDF ratio was acquired from 60%

vetch + 40% triticale parcels by 51.99%. The NDF ratio average of pure sowing and mixtures in different ratios has been defined as 57.30%.

13. It has been observed that the mixture ratio significantly affects the DMD ratio, statistically at a level of 1%, highest DMD ratio has been acquired from 40% vetch + 60% triticale parcels by 64.59% and this followed by 60% vetch + 40% triticale parcels (63.82%), statistically in the same group. Then the lowest DMD ratio was acquired from 20% vetch + 80% triticale parcels by 56.02%. The DMD ratio average of pure sowing and mixtures in different ratios has been defined as 61.56%.

14. It has been observed that the mixture ratio significantly affects the DMI ratio, statistically at a level of 1%, highest DMI ratio has been acquired from 60% vetch + 40% triticale and pure vetch parcels by 2.31%, while the lowest DMI ratio was acquired from 20% vetch + 80% triticale parcels by 1.81%. The DMI ratio average of pure sowing and mixtures in different ratios has been defined as 2.11%.

15. It has been observed that the mixture ratio significantly affects the RFV ratio, statistically at a level of 1%, highest RFV value has been acquired from 60% vetch + 40% triticale parcels by 114.21, while the lowest RFV value was acquired from 20% vetch + 80% triticale parcels by 78.43. The RFV value average of pure sowing and mixtures in different ratios has been defined as 101.02.

16. It has been observed that the mixture ratio did not have any statistically significant effects on phosphor ratios, P ratio has ranged between 0.107% and 0.167% in vetch + triticale mixture ratios. The P ratio average of pure sowing and mixtures in different ratios has been defined as 0.135%.

17. It has been observed that the mixture ratio did not have any statistically significant effects on potassium ratios, K ratio has ranged between 0.642% and 0.864% in vetch + triticale mixture ratios. The K ratio average of pure sowing and mixtures in different ratios has been defined as 0.745%.

18. It has been observed that the mixture ratio did not have any statistically significant effects on calcium ratios, Ca ratio has ranged between 0.68% and 1.14% in vetch + triticale mixture ratios. The Ca ratio average of pure sowing and mixtures in different ratios has been defined as 0.99%.

19. It has been observed that the mixture ratio did have a statistically significant effect on Mg ratios, at a level of 5%, the highest Mg ratio was acquired from 60% vetch + 40% triticale parcels by 0.322%, and it was followed by 80% vetch + 20% triticale (0.317%), pure vetch (0.270%) and 40% vetch + 60% triticale (0.257%) parcels from the same statistically same group. Then the lowest Mg ratio has been acquired from pure triticale parcels by 0.205% and 20% vetch + 80% triticale parcels by 0.220. The Mg ratio average of pure sowing and mixtures in different ratios has been defined as 0.265%.

20. It has been observed that the mixture ratio did not have any statistically significant effects on sodium ratios, Na ratio has ranged between 0.007% and 0.032% in vetch + triticale mixture ratios. The Na ratio average of pure sowing and mixtures in different ratios has been defined as 0.018%.

Based on the outcomes of this study, it has been concluded that under Bingöl conditions 80% vetch + 20% triticale mixture would be the most suitable one in terms of high crude protein yield; while 60% vetch + 40% triticale mixture would be the most suitable one in terms of low ADF and NDF ratio and highest dry matter digestibility, dry matter intake and relative food value.

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PERSONAL BACKGROUND

He was born in Duhok district in 1985. After receiving primary education in Duhok & Gavarke village, he graduated from secondary school in Duhok Government. Before coming to Bingol, he received a B.Sc. in Soil and Water (2010) from Duhok University, Kurdistan Region, Iraq. After that, he completed M. A postgraduate programme in Field Crop: Industrial Crop at Bingol University, Turkey. He looks forward working in University of Duhok. He lives with his parents.