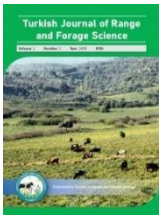
Turkish Journal of Range and Forage Science (TJRFS), 2020, 1(2): 46 – 56

Research Article

Turkish Journal of Range and Forage Science

https://dergipark.org.tr/tr/pub/turkjrfs



The Effect of Harvest Time and Urea on Yield and Yield Components of Different Grain-Legume Forage Crops

Esra GÜRSOY[1*]

[1]Department of Animal Husbandry and Nutrition, Ağrı İbrahim Çeçen University, Ağrı/ Turkey

A R T I C L E I N F O

Received 2 November 2020
Accepted 23 December 2020

Keywords:

Forage mixture
Harvest time
Hay yields
Herbage
Urea
Plant characteristics

A B S T R A C T

This study was carried out by applying different amounts of urea (0, 10 DAP 15 Urea, 10, 20 kg da^{-1}) to 5 feed mixture (Hungarian vetch (*Vicia pannonica* Crantz.), Field pea (*Pisum arvense* L.), oat (*Avena sativa* L.), Triticale (*Triticosecale* Wittmack), Wheat (*Triticum aestivum* L.) and harvesting in three different periods. It was made to determine the effect of some plant characteristics and forage yield the plants. It was carried out in 4 fields in the towns and villages of Erzincan Province during the 2019-2020 season. In the study, delaying the harvest time caused a decrease in plant characteristics and an increase in hay yield, although the effect of different applications on these properties is important, the difference in herbage yield (3712 kg da^{-1}) compared to other applications was significant (P <0.05) in the field where 10 DAP 15 Urea kg da^{-1} was applied.

1. Introduction

Animal products constitute an important and large part of human nutrition in the world. Ruminants can digest coarse feed that people can't assess and can convert them into quality animal products. Meadows and pastures are the places where quality coarse feed can be provided in terms of cheap, high quality, legume and grass species feed plants variety. With the fact that meadows and pastures become inadequate due to excessive, early, and late grazing, ruminant animals are not able to meet the need for roughage. In the case of roughage deficiency, the need for ruminants started to be farmed to eradicate this deficiency has been tried to be met. In recent years, mixed plantings have started to be involved rather than pure cultivates to obtain this variety.

The mixed feed plant cultivation method has been widely implemented to meet the growing food needs of an increasing population (Çiftçi and Ülker, 2005). The legume-grain combination has been used in various mixed planting systems, including feed and cover plants (Ramos et al., 2011). Forage crops can be planted mixed with two or more species. With mixed cultivation of forage crops; reducing pests, diseases, and weed harms (Barsila, 2018), reduce the need for fertilizer, increasing the efficiency of the next product (Ross et al., 2004), affecting the growth rate, yield, and quality of oats, wheat and vetch plants according to lean cultivation (Lithourgidis et al., 2006), enhanced soil structure and root depth to provide

*Correspondence author: esra_gursoykaya@hotmail.com

access to water (Capstaff and Miller, 2018) and increasing production per area (Ghosh, 2004) there are advantages such as.

Various fertilizer applications are carried out to improve the soil before or after planting and to increase plant nutrients that the plant will receive from the top. Urea, which is involved in various fertilizer applications; it is a very good food source for meeting the nitrogen (N) needs of plants. The urea applied to the surface is easily transported downwards by rain or irrigation water due to the easy resolution of the urea in the water. Freely roams the soil until it becomes hydrolysed in the soil, to create NH_4+ (ammonium ion). Unwanted N losses can cause decreases in product efficiency and quality (Anonymous, 2020). Fertilizer-produced urea contains 45-46% nitrogen. The use of urea has become widespread due to the low unit cost price compared to other nitrogen fertilizers. The use of urea in the soil can be used in autumn fertilization as well as in spring during certain developmental periods of plants. It has been reported that urea has a stature-makers and root-growing effect on plants, as well as affects grain development, and can be easily used in all kinds of plants with these properties (İşler ve Kılınç, 2016). Another commonly used DAP (Diammonium phosphate) fertilizer is a great source of P and N for feeding plants. It is highly soluble, which gives the plant the ability to quickly reach the root area of phosphate and ammonium (Anonymous, 2020).

The desired properties and quality of the produced forage crops, in addition to the use of fertilizer at the appropriate rate and variety, are also effective in different harvest times of the plant. It has been reported that the quality of forage crops increases with early harvesting and the amount of the product decreases, and when the form is delayed, the efficiency increases in quantity, but the quality and flavor of the forage decreases with lignification (Gürsoy and Macit, 2020).

This study was carried out to determine the effect of different harvest time and urea used in different doses to some herbal properties of the five forage mixture seeded as winter intermediate product.

2. Materials and Methods

The study was carried out during the 2019-2020 season in 4 fields located in Altınbaşak Town (2 Fields), Uluköy (1 Field), and Çatalören (1 Field) village within the borders of Erzincan Province. It was analyzed by taking soil samples 0-30 cm deep from each field. The results of the analysis of soil samples are given in Table 1.

The DAP project of the Provincial Directorate of Agriculture and Forestry is made up of 5 forage mixtures, 35% Hungarian Nuts (Tarm beyazı), 35% Feed Peas (Szarvasi andrea), 10% Oats (Kahraman), 10% Tritikale (Karma 2000) and 10% Wheat (Sönmez 2000) feed plants donated to farmers in support of feed plants.

Applications in the Study;

Control: 1. To the field, no fertilizer application has been made as a control. It was processed and raked with a crowbar before planting. On 20.09.2019, 15 kg of seeds per decare were sown with a seed drill. In total, 11 flood irrigation was carried out on the cultivated field once until harvest.

10 DAP, 15 Urea kg da^{-1}: 2. To the field before planting, 10 kg DAP was given to the second field and plowed with a plow and a rake. 15 kg of seeds per decare was planted on 01.12.2019 with a drill. 15 kg da^{-1} of urea was added to the field on 28.03.2020. Flood irrigation was carried out once until harvest on the field where 5 of them were cultivated.

10 Urea kg da^{-1}: 3. The field is mixed with gear by plowing with a plow before planting. 15 kg of seeds per decare were planted on 15.11.2019 with a seeder. 10 kg da^{-1} of urea was added to the field on 07.04.2020. Flood irrigation was carried out once until harvest on the field where 5 of them were cultivated.

20 Urea kg da^{-1}: 4. The field was plowed with a plow and pulled with a rake before planting. 15 kg of seeds per decare were planted on 15.11.2019 with a seeder. 20 kg da^{-1} of urea was added to the field on 05.04.2020. Flood irrigation was carried out once until harvest on the field where 5 of them were cultivated.

Different urea doses and DAP application were made in line with the preferences of the breeders in the fields where the feed mixture was grown. No fertilizer application was made in a control field either.

Table 1. Soil Analysis Results of Research Locations

	Soil Structure	**pH**	**Organic Matter**	**Lime**	**Salt**	**Potassium (K_2O ha^{-1})**	**Phosphorus (P_2O_5 ha^{-1})**
1.Field (Control)	Loam	Slightly alkaline	Middle	Medium lime	Without salt	High	Poor
2. Field (10 DAP+15 Urea kg da^{-1})	Loam	Strong alkaline	Little	Middle lime	Without salt	High	Poor
3. Field (10 Urea kg da^{-1})	Clay – Loam	Strong alkaline	Middle	Excess lime	Without salt	Middle	Poor
4. Field (20 Urea kg da^{-1})	Loam	Strong alkaline	Middle	Limy	Without salt	Little	Poor

Climate data

During the trial period, the temperature, precipitation, and humidity information of Erzincan Province was taken from the General Directorate of Meteorology and given in Table 2. While the temperature was the lowest in February during the study, the highest was in June. Precipitation was less in the province during the trial, and the highest humidity was observed in December. The fact that precipitation is less than years in the province is an extreme situation and it is thought to be caused by climate change due to global warming (Kibar et al., 2014).

Table 2. Erzincan Province 2019-2020 Temperature, Rainfall and Humidity Ratios by Months

	Temperature ^0C	Rainfall mm	Humidity %
October	15.47	0.25	46.53
November	6.03	0.42	50.90
December	5.20	0.25	65.78
January	0.28	0.50	57.76
February	0.08	1.37	63.35
March	8.18	1.78	55.27
April	13.6	0.89	46.12
May	15.92	1.94	47.25
June	26.66	0.12	40.52
July	25.67	0.01	34.63

Method

In the study, 3 harvested times were made by considering 3 shaping times. The first harvest of forage peas was made on 13.05.2020 in 4 fields, leaving 50 cm of edge effect from the heads of the plots, and a 5 m^2 area to represent the field with the help of a sickle. The second harvest was realized on 02.06.2020 in a 5 m^2 area with an edge effect representing the field when the flowering of the forage pea is 50%. The third harvest was done on 16.06.2020 in a 5 m^2 area with an edge effect during full flowering.

Plant height (cm) was calculated by measuring and averaging the heights from the soil surface to the plant tip point of 10 plants, representing each plant species from the fields at all three harvest times. The number of leaves (number/plant) was counted by counting the number of branches and leaves of the plants and proportioned to the plant number (Sabancı, 1996; Özyiğit and Bilgen, 2006; Yücel 2019), and the distance from the leaf tip to the base of the leaf blade in cereals was determined as leaf length (cm) (Yurtman, 1969; Sevim, 2013). The stem diameter (mm) was measured in mm with an electronic caliper between the second and third nodes of the longest stem in each plant (Tekeli and Ateş, 2006). Herbage (kg da -1) was weighed by reaping a 5 m2 area from each field with a sickle from the soil level in three harvest periods and the yield per decare was found by calculating from the value obtained (Sevim, 2013). In order to determine the hay yield in each parcel, 500 g of hay samples were taken and dried in the oven set at 78 °C for 24 hours, then weighed and the values obtained were converted to decares and the hay yields were calculated (Yücel, 2019).

In order to compare the data obtained as a result of the study, they were subjected to variance analysis in the SPSS 24 package program, and the Duncan comparison test was applied to compare groups.

3. Results and Discussion

Plant Height

The effect of different harvest times and different urea doses on the plant height of the feeds in the mixture is given in Table 3.

Table 3. Average Values of Feeds in the Mixture of Different Harvest Times and Different Urea Dosages (cm)

	Field Pea plant height				**Hungarian Vetch plant height**			
	Harvest time				**Harvest time**			
Urea kg da^{-1}	**1**	**2**	**3**	**Aver**	**1**	**2**	**3**	**Aver**
0	90.66	156.33	156.66	**134.55a**	80.33	121.33	124.66	**108.77b**
10 DAP 15	99.83	158.66	158.66	**139.05a**	111.00	136.00	136.00	**127.66a**
10	79.83	102.33	103.66	**95.27c**	75.00	92.00	105.16	**90.72c**
20	65.00	108.33	**159.33**	**110.88b**	40.00	79.00	106.33	**75.11d**
Aver	**83.83 C**	**131.41B**	**144.58A**		**76.58C**	**107.08B**	**118.04A**	

	Oat plant height				**Triticale plant height**				**Wheat plant height**			
	Harvest time				**Harvest time**				**Harvest time**			
Urea kg da^{-1}	**1**	**2**	**3**	**Aver**	**1**	**2**	**3**	**Aver**	**1**	**2**	**3**	**Aver**
0	96.33	102.33	106.66	**101.77ab**	60.16	104.00	104.00	**89.38c**	93.50	128,33	128.33	**116.72b**
10 DAP 15	92.83	111.33	112.33	**105.50a**	106.33	115.33	117.66	**113.11ab**	119.00	130.00	130.10	**126.36a**
10	93.83	97.33	98.33	**96.50b**	114.33	119.66	123.00	**119.00a**	103.00	108.00	108.33	**106.44c**
20	56.33	86.50	98.00	**80.27c**	69.50	104.00	120.33	**97.94b**	77.00	90.33	100.00	**89.11d**
Aver	**84.83 B**	**99.37A**	**103.83A**		**87.58C**	**110.75B**	**116.25A**		**98,12B**	**114.16A**	**116.69A**	

Significant difference between averages indicated by different letters in the same row or column (P<0.05)

In the study, the effect of both the harvest time and the applied urea at different doses on the average height of the plants was significant (P <0.05). The height of the plants in the mixture in the application areas increased as the harvest time was delayed. The average height of Pea vetch, Oat, Triticale and Wheat plants respectively; It ranged between 95.27-139.05 cm, 75.11-127.66 cm, 80.27-105.50 cm, 89.38-119.11 cm and 89.11-126.36 cm (Table 3). The average height of Pea, Vetch, Oat, Triticale and Wheat plants was found to have the highest value in the field where 10 DAP 15 Urea kg da $^{-1}$ was applied (139.05, 127.66, 105.50, 113.11, 126.36 cm). According to these data, it is seen that the plant continues its development with the advancement of the harvest time. The use of DAP fertilizer with the effect of urea to grow height and root growth in plants has shown that it provides a more increase in plant height values in plants. It can be considered that the plant height in the feed mixture is not affected much of Pea vetch crop compared according to other feed crops in terms of plant competition.

The plant height of the feed pea was found to be lower than the value found by Doğan (2013), higher than the value found by some researchers (Özköse, 2017; Yücel, 2019) and similar to some study values (Sevim, 2013; Kara, 2016). While the average plant height of Hungarian Vetch was similar to the value found by Orak et al

(2004) it was higher than the values reported by the researchers of Bağcı (2010), Şimşek (2015), Kandış (2019), and Yücel and Bengisu (2019). While the average plant height of oat and triticale plants is similar to some study results (Sevim, 2013; Kara, 2016; Çeri, 2019), oat plant height is lower than the value reported by Çalışkan and Koç (2019). The average Wheat plant height in the study was determined to be similar to the values reported by Doğan (2013) and Sevim (2013).

Side Branch / Number of Leaves

The effect of different harvest times and different urea doses on the number of plant side branches/leaves of feeds in the mixture is given in Table 4. While the number of side branches increased (10-14.25-4.58 units/plant) in the feed pea with the delay of the harvest time, the number in the control group (13.77 units / plant) in the applications was found to be significant compared to the other applications (P <0.05). Different doses of urea application in feed peas had a negative effect compared to the control group. In other words, urea applications did not increase the number of side branches in feed peas. While these values are similar to Öztürk's (2009) study (11.06 <12.24 units/plant), they are lower than Yücel's (2019) (17.26 units/plant) and higher than Ateş and Tekeli's (2017) (4 <6 plants/plant). It was found to be high.

While there was no difference between applications in the number of side branches of Hungarian vetch in the mixture, it got the highest value at the second harvest time (14.83 units/plant) (P <0.05). In Hungarian vetch, it is thought that as the plant matures, the side branches dry and fall off. The number of Hungarian vetch side branches in different applications is similar to the values found by Yücel (2019) but higher than the results of Orak et al. (2004).

While there was a decrease in the number of leaves with the delay of harvest time in cereals, the difference between the second group and the other groups was found to be significant in the applications of Oat and Triticale plants (P <0.05). No difference was found between the applications in thewheat plant (P> 0.05). Oat, Triticale and Wheat plant leaf counts decreased as the harvest time was delayed. While the second group urea application shows a positive effect in the oat plant, In the triticale plant, it was observed that 10% and 20% urea applications were effective in the number of leaves. The number of oat plant leaves (3 <4 units/plant) was lower than the values found in the studies of some researchers (Çalışkan ve Koç, 2019; Çeri, 2019) (4.49-5.8 units/plant).

Leaf Length

The effect of different harvest times and different urea doses on the leaf length of the creals in the mixture is given in Table 5. Significant differences were observed in the leaf length of the creals in the mixture, being more in the second group between applications (P <0.05). The effect of harvest time on leaf length of plants was significant (P <0.05). Oat and Triticale leaf length decreased with the delay of harvest time, but there was no difference between the second harvest time and the third harvest time. Leaf length decreased with the delay of harvest time in wheat plants (Table 5). This is thought to be due to the drying and shedding of some leaves as the harvest time is delayed.

Oat leaf size was similar to the values reported by Sevim (2013) and Çeri (2019), but lower than the value reported by Çalışkan and Koç (2019). Triticale leaf length is similar to the results determined by Kara (2013), higher than Sevim's (2013) leaf length results, Wheat leaf length is lower than Doğan's (2013) leaf length results, higher than Sevim's (2013) results, Kara et al. (2008) showed a similar value with the results of.

Stalk Thickness

The effect of different harvest times and different urea doses on stalk thickness of feeds in the mixture is given in Table 6. In plants, it is preferred that the stem diameter is thin (Dogan, 2013). The effect of different applications on the stalk thickness of plants was significant in Hungarian vetch and Oat plant (P <0.05). It was determined that with 10% urea application in Hungarian vetch the stem thickness was the thinnest (2.52 mm). The application with the thickest stem thickness was seen in the second application (3.64 mm).

Table 4. Average Values of Different Harvest Times and Different Urea Dosages Regarding the Number of Plant Side Branches / Leaves (unit/plant) in the Mixture

	Field pea side branches				**Hungarian vetch side branches**			
	Harvest time				**Harvest time**			
Urea kg da $^{-1}$	**1**	**2**	**3**	**Aver**	**1**	**2**	**3**	**Aver**
0	10	16	15.33	**13.77a**	11.33	14	13.33	**12.88**
10 DAP 15	9.33	14.33	15	**12.88ab**	12.66	15.66	13.33	**13.88**
10	11.66	13	13.66	**11.88b**	11.33	14	13.66	**13**
20	10	13.66	14.33	**13.22ab**	11.33	15.66	14.33	**13.77**
Aver	**10B**	**14.25A**	**14.58A**		**11.66C**	**14.83A**	**13.66B**	

	Oat leaf count				**Triticale leaf count**				**Wheat leaf count**			
	Harvest time				**Harvest time**				**Harvest time**			
Urea kg da $^{-1}$	**1**	**2**	**3**	**Aver**	**1**	**2**	**3**	**Aver**	**1**	**2**	**3**	**Aver**
0	4	5	3	**4b**	4.66	5.66	5.33	**5.22a**	4.66	5	4.66	**4.77**
10 DAP 15	4.66	5	4	**4.55a**	5	4	3.66	**4.22b**	4.66	5	3.33	**4.33**
10	4	4.33	3.33	**3.88b**	5.33	5.66	4	**5a**	4.66	5	4	**4.55**
20	4	4.33	4	**4.11b**	5	5.66	4	**4.88a**	4.66	4.66	3.66	**4.33**
Aver	**4.16B**	**4.66A**	**3.58C**		**5A**	**5.25A**	**4.25B**		**4.66A**	**4.91A**	**3.91B**	

There is a significant difference between the means indicated by different letters in the same row or column (P <0.05) (P<0.05

Table 5. Average Values of Different Harvest Times and Different Urea Dosages Regarding the Leaf Size of the Creals (cm) in the Mixture

	Oat leaf height				**Triticale leaf height**				**Wheat leaf height**			
	Harvest time				**Harvest time**				**Harvest time**			
Urea kg da $^{-1}$	**1**	**2**	**3**	**Aver**	**1**	**2**	**3**	**Aver**	**1**	**2**	**3**	**Aver**
0	13.16	19.93	18.66	**17.25b**	22.66	23	20.66	**22.11c**	26.33	26.66	24.33	**25.77a**
10 DAP 15	19.83	25.66	25	**23.5a**	27	29	29.66	**28.55a**	25	26.66	25.66	**25.77a**
10	18.33	19	18.8	**18.71b**	15.66	19.53	16.83	**17.34d**	20.5	23.83	19.66	**21.33b**
20	18.66	19.5	18.66	**18.94b**	19.5	28.10	27.66	**25.08b**	21.66	27.76	25.5	**24.97a**
Aver	**17.5B**	**21.02A**	**20.28A**		**21.20B**	**24.90A**	**23.70A**		**23.37B**	**26.23A**	**23.79B**	

There is a significant difference between the means indicated by different letters in the same row or column (P <0.05)

While the difference between oats stalk thickness and applications was not significant, the thinnest stalk thickness was realized in the control group (2.63 mm). While the effect of harvest time was significant (P <0.05) in all plants, stem thickness of Oat and Triticale plants decreased significantly (3.70-4.08 mm) as the harvest time was delayed (Table 6). As the harvest time was delayed, stem thickness values generally decreased.

The stem thickness of the feed pea was similar to the results of some researchers (Sevim, 2013;

Ömeroğlu, 2016) higher than the results of Yolcu et al. (2009) and lower than the results of Doğan (2013).

The Hungarian vetch has been higher than the results of Bağcı (2010). While oat plant stem thickness from cereals was higher than the results of some researchers (Çeri, 2019; Çalışkan and Koç; 2019), it was determined to be similar to the stem thickness found by Yolcu et al. (2009) and lower than the results of Sevim (2013). While the stem thickness of Triticale and Wheat plants were found to be lower than the value determined by Sevim (2013), it was determined that the Triticale plant stem thickness was similar to the values found by Yolcu et al. (2009) and the wheat plant by Doğan (2013).

Table 6. Average Values of Different Harvest Times and Different Urea Dosages Regarding Stem Thickness (mm) of Feed in the Mixture

	Forage pea stalk thickness				**Hungarian vetch stalk thickness**			
	Harvest time				**Harvest time**			
Urea kg da $^{-1}$	**1**	**2**	**3**	**Aver**	**1**	**2**	**3**	**Aver**
0	1.06	4.66	4	**3.24**	1.7	4	3.66	**3.12ab**
10 DAP 15	1.1	4	3.66	**2.92**	1.6	5	4.33	**3.64a**
10	1.4	4.33	4.16	**3.3**	1.23	3.33	3	**2.52c**
20	1.6	4	3.33	**2.97**	1.7	3	3.33	**2.67bc**
Aver	**1.29B**	**4.25A**	**3.79A**		**1.55B**	**3.83A**	**3.58A**	

	Oat stalk thickness				**Triticale stalk thickness**				**Wheat stalk thickness**			
	Harvest time				**Harvest time**				**Harvest time**			
Urea kg da $^{-1}$	**1**	**2**	**3**	**Aver**	**1**	**2**	**3**	**Aver**	**1**	**2**	**3**	**Aver**
0	1.23	3.33	3.33	**2.63b**	1.13	5	4.33	**3.48**	1.36	4.6	4	**3.34**
10 DAP 15	1.13	4.66	3.36	**3.15a**	1.3	4.83	3.33	**3.15**	1.43	4.4	4	**3.27**
10	1.4	4.66	3.36	**3.24a**	1.16	5	4.16	**3.44**	1.46	5	5	**3.82**
20	1.36	4.66	4.16	**3.4a**	1.23	4.33	4.5	**3.35**	1.36	5	4,83	**3.73**
Aver	**1.28C**	**4.33A**	**3.70B**		**1.20C**	**4.79A**	**4.08B**		**1.40B**	**4.76A**	**4.45A**	

There is a significant difference between the means indicated by different letters in the same row or column (P <0.05)

Leaf / Stalk Ratio

The effect of different harvest times and different urea doses on the leaf/stalk ratio of feeds in the mixture is given in Table 7. Among the different applications, it was determined that the leaf stalk ratio was higher and significant in the field where 10 DAP 15 Urea kg da $^{-1}$ was applied in Feed pea, Hungarian vetch, Oat, and Wheat plants (P <0.05). The leaf/stalk ratio of the triticale plant did not differ between applications (P> 0.05). The leaf / stem ratios of oat and Hungarian vetch were similar in the control group and the second group of urea application, and they were higher than the other applications, and the difference was significant (P <0.05). The effect of harvest time on the leaf/stalk ratio is significant (P <0.05) in the plants included in the fives feed mixture, and it was observed that the leaf/stem ratio of Feed pea, Hungarian vetch, and Wheat plants decreased as the harvest time was delayed. While the feed pea leaf/stalk ratios are similar to the values reported by Özyiğit and Bilgen (2006), Sevim (2013), they are lower than the values reported by Doğan (2013). Oat, Triticale, and Wheat plant leaf/stalk ratios are lower than the values determined by Sevim (2013), Oat leaf/stalk ratios are similar to the rates

specified by Çeri (2019) and Wheat leaf/stalk ratios are lower than those stated by Doğan (2013).

Table 7. Average Values of Different Harvest Times and Different Urea Dosages Regarding the Leaf/Stalk Ratio (%) of the Feed in the Mixture

	Foraged pea leaf/stalk				**Hungarian vetch leaf/stalk**			
	Harvest time				**Harvest time**			
Urea kg da^{-1}	**1**	**2**	**3**	**Aver**	**1**	**2**	**3**	**Aver**
0	0.96	1.42	0.98	**1.12c**	0.93	1.32	1.30	**1.19a**
10 DAP 15	1.28	2.46	1.65	**1.80a**	1.13	1.27	1.19	**1.19a**
10	1.86	2.01	1.13	**1.67ab**	0.77	1	0.69	**0.82b**
20	1.19	1.41	1.14	**1.25bc**	1	1.83	0.88	**1.24b**
Aver	**1.32B**	**1.82A**	**1.22B**		**0.96B**	**1.35A**	**1.02B**	

	Oat leaf/stalk				**Triticale leaf/stalk**				**Wheat leaf/stalk**			
	Harvest time				**Harvest time**				**Harvest time**			
Urea kg da^{-1}	**1**	**2**	**3**	**Aver**	**1**	**2**	**3**	**Aver**	**1**	**2**	**3**	**Aver**
0	0.31	0.57	0.52	**0,47a**	0.12	0.24	0.23	**0.20**	0.24	0.21	0.18	**0.21ab**
10 DAP 15	0.35	0.67	0.44	**0,49a**	0.13	0.24	0.25	**0.21**	0.22	0.26	0.21	**0.23a**
10	0.20	0.31	0.17	**0,23b**	0.21	0.26	0.18	**0.22**	0.16	0.18	0.15	**0.16b**
20	0.25	0.31	0.25	**0,27b**	0.10	0.23	0.13	**0.15**	0.17	0.28	0.15	**0.22ab**
Aver	**0.28B**	**0.46A**	**0.34AB**		**0.14B**	**0.24A**	**0.19AB**		**0.20AB**	**0.23A**	**0.17B**	

There is significant difference between the means indicated by different letters in the same row or column (P <0.05)

Herbage and Hay Yields

The effect of different harvest times and different urea doses on the herbage and hay yields of the five-forage mixture is given in Table 8.

The highest herbage yield of the feed mixture was 50% (2nd harvest) in the flowering period (3352.7 kg da^{-1}) of the forage pea. As the harvest time was delayed, herbage yield decreased. The difference between herbage yield rates at harvest time of forage was found to be significant (P <0.05). The effects of control group and other urea applications on herbage yield of mixed forage plants were the same.

Among the applications, the highest rate of herbage yield (3712 kg da^{-1}) was observed in the field where 10 DAP 15 Urea kg da^{-1} was applied. The difference between this ratio and other applications was significant (P <0.05).

The average values (2731.33 - 2933.66 - 3000.77 - 3712 kg da^{-1}) among herbage yield applications are higher than the mixture herbage yield determined by some researchers (Kara, 2016; Yücel, 2019), lower than some values (Doğan, 2013; Sevim, 2013; Tükel et al., 1991), Tükel and Hatipoğlu (1987) were found to be similar to the value of herbage yield.

While the differences between hay yield in the feed mixture at different harvest times were significant (P <0.05), there was no difference between the applications (P> 0.05). Second and third harvest time hay yield (1094.50 kg da^{-1}, 1057.94 kg da^{-1}) was higher than the first harvest time hay yield (487.41 kg da^{-1}). It has been observed that hay yield increases as the harvest time is delayed. These results were found to be higher than the average hay yield in studies conducted with mixed fodder crops (Kaya, 2012;

Şimşek, 2015; Kara, 2016; Yücel, 2019) and similar (Yavuz and Karadağ, 2016).

Plant height, leaf branch/leaf number, leaf length, stalk thickness, leaf/stalk ratio, herbage yield values and hay yield of the five-feed mixture in the study are different from the values obtained from the studies on this subject, climate change, soil structure difference, feed It is thought that the mixture ratio and variety difference is due to the irrigation time, the number of irrigation and the different types and ratios of fertilizers applied to the soil.

Table 8. Average Values of Herbage and Hay Yield (kg da^{-1}) of Five Forage Mixture at Different Harvest Times and Different Urea Doses

	Herbage Yield (kg da^{1})				**Hay Yield (kg da^{1})**			
	Harvest time				**Harvest time**			
Urea kg da^{1}	**1**	**2**	**3**	**Aver**	**1**	**2**	**3**	**Aver**
0	2296	3248	2650	**2731.33b**	353.52	1175.72	964.03	**831.09**
10 DAP 15	3686	4000	3450	**3712a**	574.16	1453.94	1169.29	**1065.80**
10	2100	3413	3288	**3000.77b**	651.48	919.53	1063.60	**878.20**
20	1573	2750	2615	**2933.66b**	370.48	828.83	1034.83	**744.71**
Aver	**2413.7B**	**3352.7A**	**3000.7AB**		**487.41B**	**1094.50A**	**1057.94A**	

There is a significant difference between the means indicated by different letters in the same row or column (P <0.05)

5. Conclusion

In Erzincan Province and similar ecologies, depending on the soil content in the sowing of the livestock forage mixture, 10 DAP 15 Urea kg da^{-1} application gives the best results in terms of the agronomic properties and green herbage yield of the plants, the most appropriate harvest time is seen as a decrease in the values by delaying the harvest time. It was observed to be in the 50% flowering period. It is thought that similar studies should be done in different ecologies.

References

Anonymous, 2020. http:/www.ipni.net/publication/nss.nsf/0/5FE74632D6D80872852579AF00706626/$FILE/NSS-01%20Urea.pdf.

Ateş E, Tekeli AS., 2017. The effect of different base fertilizer applications on forage yield and quality of forage pea (*Pisum arvense* L.). KSÜ Nature Know. Journal, 20 (Special Issue): 13-16.

Bağcı M., 2010. Effects of row spacing and seed amount on grass yield in Hungarian vetch (Vicia pannonica crantz. Cv. Tarmbeyazı-98) in Central Anatolia conditions. Çukurova University, Institute of Science, Field Crops Department, Master Thesis, Adana.

Barsila SR., 2018. The fodder oat (*Avena sativa*) mixed legume forages farming: nutritional and ecological benefits. Journal of Agriculture and Natural Resources, 1(1):206-222.

Capstaff NM, Miller AJ., 2018. Improving the yield and nutritional quality of forage crops. Front. Plant Sci. 9:535. doi: 10.3389/fpls.2018.00535.

Çalışkan M, Koç A., 2019. Morphological characterization of local oat genotypes belonging to the western Mediterranean region. Journal of Field Crops Central Research Institute, 28 (1): 7−18.

Çeri S., 2019. Investigation of grass yield, yield components and some quality characteristics of some oat varieties and lines in Konya watery conditions. Selcuk Unv. Science Inst., Field Crops Department, Master Thesis, Konya.

Çiftçi V, Ülker M. 2005, Effect of mixed cropping lentil with wheat and barley at different seeding ratios. – Journal of Agronomy, 4(1):1-4.

Doğan Bİ., 2013. Determination of yield components and forage values of forage pea (Pisum arvense L.) - wheat (*Triticum aestivum* L.) mixtures. Namık Kemal University, Institute of Science, Field Crops Department, Master Thesis, Tekirdağ.

Ghosh PK., 2004. Growth, yield, competition and economics of groundnut/cereal fodder intercropping systems in the semi-arid tropics of India. – Field Crops Research 88:227-237.

Gürsoy E, Macit M., 2020. The effect of harvest time on the chemical composition and quality of coarse feed. Euroasia Journal of Mathematics, Engineering, Natural & Medical Sciences International Indexed & Refereed, www.euroasiajournal.org, 8(9):168-177.

İşler N, Kılınç M., 2016. Field agriculture. Mustafa Kemal University Faculty of Agriculture, Textbook, Hatay, (184).

Kandış T., 2019. Determination of grass yield and quality of Hungarian vetch (*Vicia pannonica*) and Italian turf (*Lolium italicum*) planted at different planting rates. Ordu Unv. Know Science. Inst., Field Crops Department, Master Thesis, Ordu.

Kara R, Dumlupınar Z, Akkaya A, Dokuyucu T., 2008. Evaluation of some durum wheat genotypes in terms of phenological periods, some plant characteristics and grain yield in Kahramanmaraş conditions. KSU Journal of Science, 11(1):104-111.

Kara S., 2013. Effect of post-flowering ethephon applications on grain yield, yield components and grain protein in triticale. Ankara University, Institute of Science, Field Crops Department, Master Thesis, Ankara.

Kara E., 2016. Determination of yield and quality characteristics of some annual legume and poaceae forage crops to be grown as winter intermediate crops in Aydın conditions. Adnan Menderes Unv., Know Science. Inst., Forage Crops Department, Master Thesis, Aydın.

Kaya, M., 2012. Specifying The Organic Matter Efficiency Features of Some Cereal-Pulse Mixtures to The Soil, The Graduate School of Natural and Applied Science of Selçuk University The Degree of Master of Science / Doctor of Philosophy, Master Thesis, Konya.

Kibar, H., Kibar, B., Sürmen, M., 2014. Effects on the Pattern of Plant Crop of Temperature and Precipitation Change in Igdir Province, Journal of Adnan Menderes University Agricultural Faculty, 11(1) : 11 – 24.

Lithourgidis AS. Vasilakoglou IB, Dhima KV, Dordas CA, Yiakoulaki MD., 2006. Forage yield and quality of common vetch mixtures with oat and triticale in two seeding ratios. Field Crops Res. 99:106-113.

Orak A, Ateş E, Varol F., 2004. Nutrient content relationships with some morphological and agricultural characteristics of Hungarian vetch (*Vicia pannonica* Crantz.) In different development periods. Journal of Agricultural Sciences, 10(4): 410-415.

Ömeroğlu E. 2016. Determination of grass and seed yields and some yield components of some forage pea (*Pisum arvense* L.) varieties in Isparta conditions. Süleyman Demirel Unv. Institute of Science, Field Crops Department, Master's Thesis, Isparta.

Özköse A., 2017. The effects of different sowing depths on yield and some yield characteristics of feed peas. Sakarya University Journal of Science and Technology, 21(6):1188-1200.

Öztürk M., 2009. Effects of zinc fertilization on yield and quality in some winter fodder crops. Adnan Menderes Unv. Institute of Science, Field Crops Department, Master's Thesis, Aydın.

Özyiğit Y, Bilgen M., 2006. The effect of different shape periods on some quality factors in some legume forage crops. Akdeniz University Faculty of Agriculture Journal, 19:29-34.

Ramos ME, Altieri MA, Garcia PA, Robles AB., 2011. Oat and oat-vetch as rainfed fodder cover crops in semiarid environments: Effects of fertilization and harvest time on forage yield and quality. – Journal of Sustainable Agriculture 35:726-744.

Ross SM, King JR, O'Donovan JT, Spaner D., 2004. Forage potential on intercropping berseem clover with barley, oat, or triticale. Agronomy J., 96(4):1013-1021.

Sabancı CO., 1996. A research on the evaluation of vetches (*Vicia sativa* L.) collected from different regions in terms of some characters. Turkey 3 and Meadow Forage Crops Congress, Erzurum. June 17-19.

Sevim T., 2013. Determination of the effective characters on yield and yield in different grain-feed pea (*Pisum arvense* L.) mixtures. Namık Kemal Unv., Know Science. Inst., Field Crops Department, Master Thesis, Tekirdağ.

Şimşek S., 2015. Determination of the effects of different Hungarian vetch (*Vicia pannonica* Crantz) + Italian grass (*Lolium multiflorum* Lam.) mixing ratios on yield and quality in Kırşehir

conditions. Ah Evran Unv. Know Science. Inst., Field Crops Department, Master Thesis, Kırşehir.

Tekeli AS. Ateş E., 2006. Legume forage crops. Trakya University Tekirdağ Faculty of Agriculture. Publication No. 293, Textbook, Tekirdağ. No.42, 153.

Tükel TK, Hatipoğlu R., 1987. A study on the feed production potential of some annual legume + cereal mixtures in Çukurova basement lands at different times. Doğa Tübitak Journal of Agriculture and Forestry, 2(3):558-566.

Tükel T, Anlarsal AE, Tansı V, Sağlamtimur T, Gülcan T., 1991. The possibilities of growing forage crops as winter intermediate crops in Çukurova. 2. Forage Crops Congress of Turkey Pastureland Bornova/İzmir. (28-31 Mayıs 1991), 302-310.

Yavuz, T., Karadağ, Y., 2016. Performances of Some Forage Grasses, Legumes and Their Mixtures Under Dry Pasture Conditions, Journal of Agricultural Faculty of Gaziosmanpasa University, 33(2), 63-71.

Yolcu H, Daşçı M, Tan M., 2009. Determination of yield and some characteristics of feed pea + grain mixtures planted in different proportions. Turkey VIII. Field Crops Congress (19-22 October), Volume I, Poster Presentations, Hatay. 846-849.

Yurtman N., 1969. Plot trial method guide for meadow, pasture and forage crops. Ankara Meadow-Pasture and Forage Crops Animal Science Research. Ens. Arrow. No:4, 33s.

Yücel N., 2019. The effect of nitrogen fertilization on yield and yield components in some annual legume forage crops. Harran University, Know Science. Inst., Field Crops Major. Department., Master's thesis, Şanlıurfa.

Yücel N, Bengisu G. 2019, The effect of nitrogen fertilization on yield and yield components in some annual legume forage crops. International Journal on Mathematic, Engineering and Natural Sciences, 3(11):141-145.