



Effects of mixture ratio and cutting time on forage yield and silage quality of intercropped berseem clover and italian ryegrass

Celal Yucel^{*1}, Ilker Inal¹, Derya Yucel¹ and Rustu Hatipoglu²

Eastern Mediterranean Agricultural Research Institute,
Adana-TURKEY.

Received: 25-12-2017

Accepted: 05-05-2018

DOI: 10.18805/LR-400

ABSTRACT

The research was carried out to determine the effects of different mixture ratios and cutting times on dry-matter yield and silage quality of mixtures of berseem clover (*Trifolium alexandrinum* L.) with Italian ryegrass (*Lolium multiflorum* Lam.) in Adana province, Turkey. The experiment was laid out in split plot design with four replications during the years of 2011-2013. The mixture-ratios (80% BC + 20% IR, 60% BC + 40% IR, 40% BC + 60% IR, 20% BC + 80% IR, pure berseem clover (BC) and Italian ryegrass (IR)) were main plots, and harvest times (beginning of the flowering, mid flowering and full flowering of BC) were sub-plots. From the result of the study, it was concluded that the mixture of 60% BC + 40% IR harvested at full flowering of BC was superior in terms of dry matter yield and silage quality.

Key words: Berseem clover, Cutting time, Italian ryegrass, Mixture ratio, Silage quality.

INTRODUCTION

Berseem clover is a valuable, high-yielding annual forage legume and well adapted to a wide range of environments for grazing and hay production. Intercropping berseem clover with cereals has increased the yield and quality of cereal forage crops in India (Singh *et al.*, 1989). Martiniello *et al.* (1996) found that cutting applied at early stage of development reduces root reserves, decreases subsequent yield and plant survival of berseem. It is a suitable companion crop for barley, annual ryegrass, triticale and oats. In particular, forage quality of cereals is usually not high enough to meet satisfactory production levels of many categories of livestock. Small grain cereals provide high yields in terms of dry matter but produces forage with low crude protein (Lawes and Jones, 1971).

In intercrops, companion cereals provide structural support for legume growth, improve light interception and facilitate mechanical harvest, while legumes generally increase the protein and mineral content of the forage (Robinson, 1969). However, berseem clover forage diets could cause livestock bone abnormalities due to its incorrect ratio of Ca to P (Hall *et al.*, 1991) and bloat due to the indigestible oligosaccharide content (Foley *et al.*, 1972). Generally, mixtures of legumes with cereals greatly improve the ratio of Ca to P and decrease the incidence of pasture bloat.

In Turkey, roughage production for the animals of 16.5 million Animal Unit is at inadequate levels. East Mediterranean part of Turkey being blessed with Mediterranean climate conditions facilitate cropping annual

legumes like berseem clover or vetch in sole or mixed with cereals like triticale or Italian ryegrass and to place legumes in crop rotations paving way to obtain high quality roughage. Berseem clover is an appropriate species for winter conditions of this region which yields 12-14 t/ha dry matter under these conditions (Yucel *et al.*, 2016).

Berseem clover constituted only 14 per cent of the forage yield in a 50:50 seeding rate in intercrop of BC with IR (Caballero *et al.*, 1994). Karakurt and Ekiz (1996) reported that the highest dry matter yield (4.49 t ha⁻¹), crude protein rate (14.84%) and protein yield were obtained from 80 per cent BC-20 per cent IR mixtures.

The objective of this study was to determine the effects of different harvest times and seeding rates on the yield and silage quality of BC-IR mixtures under Mediterranean conditions of Turkey.

MATERIALS AND METHODS

The experiment was conducted at the Eastern Mediterranean Agricultural Research Institute; Adana, Turkey (36° 51.675 N, 035° 20.662 E, altitude 14 m above sea level) under rainfed management conditions during the years of 2011-2013 under typical Mediterranean climate with mild rainy winter and hot dry summer. Climatological data from November to May during the years of 2011-2013 are shown in Table 1 (Anonymous, 2017).

The soil is silty-clay (sand 27.8%; clay 31.2% and silt 41%); total content of salts was 0.026%, organic matter content 2.0%, pH level 7.72, and P level 87.0 kg/ha and rich in term of lime.

*Corresponding author's e-mail: celalyucel1@gmail.com

¹Eastern Mediterranean Agricultural Research Institute, Karatas Road 17th Km, Adana-TURKEY.

²Cukurova University, Faculty of Agriculture, Department of Field Crops, Balcalı, Sarıcam, Adana-TURKEY.

Table 1: Some meteorological data for Adana province (2011-2013).

Month	Air Temperature (°C)						Relative Humidity (%)		Total Precipitation (mm)	
	2011-2012			2012-2013			2011-12	2012-13	2011-12	2012-13
	Min	Max	Mean	Min	Max	Mean				
November	6.9	18.7	12.6	11.8	23.1	17.4	52.3	52.3	34.5	187.0
Long Term*	10.6	22.6	15.5				63.0		71.1	
December	4.3	16.2	10.0	7.3	15.8	11.4	65.2	73.0	225.4	154.4
Long Term	6.8	16.7	11				67.0		120.1	
January	4.5	12.4	8.2	4.9	14.4	9.5	75.3	66.8	302.0	25.9
Long Term	5.1	14.8	9.4				65.0		108.2	
February	3.1	14.4	8.6	6.9	17.4	12.1	58.3	73.9	153.3	49.0
Long Term	5.9	16.0	10.4				65		91.0	
March	5.5	17.4	11.4	7.9	19.8	13.9	55.4	61.1	13.4	70.1
Long Term	8.2	19.4	13.3				65		65.4	
April	11.5	24.8	18.1	12.1	24.1	18.1	68.3	72.0	36.0	43.2
Long Term	11.8	23.6	17.3				67.0		51.2	
May	15.4	26.5	20.8	16.3	29.4	22.7	74.0	72.3	97.0	57.4
Long Term	15.7	28.2	21.6				66.0		47.3	
Mean/Total	7.3	18.6	12.8	9.6	20.6	15.0	64.1	67.3	861.6	587.0

Long Term (1927-2016),

Table 2: Berseem Clover Ratios in Dry Matter Yields of Mixtures.

Treatment	Harvest Stage	2012	2013	Mean
80 BC-20 G	H1	67.8	71.3	69.6 a ³
	H2	63.3	73.1	68.2 a
	H3	61.6	50.5	56.0 b
	Mean	64.2 a¹	65.0 a	64.6 A*
60 BC-40 G	H1	47.8	44.5	46.2 c
	H2	32.3	41.9	
	H3	39.5	24.3	31.9 e
	Mean	39.9 bc	36.9 c	38.4 B
40 BC-60 G	H1	47.3	27.2	37.2 d
	H2	41.5	23.6	32.6 e
	H3	39.4	10.3	24.8 f
	Mean	42.7 b	20.4 e	31.5 C
20 BC-80 G	H1	25.7	18.2	22.0 fg
	H2	28.6	11.5	20.1 g
	H3	19.5	10.2	14.9 h
	Mean	24.6 d	13.3 f	19.0 D
Mean (year)		42.9 A+	33.9 B+	
Harvest Stage Means				
H1		47.2 a ²	40.3 b	43.7 A*
H2		41.4 b	37.5 c	39.5 B
H3		40.0 b	23.8 d	31.9 C
CV (%)			8.10	

*) The means with the same capital letter in the same column are not statistically significant different from each other according to the Duncan test at $P \leq 0.05$

+) The means with the same capital letter in the same row are not statistically significant different from each other according

1) The means of different year-treatment combinations with the same lower case are not statistically significant different from each other according to the Duncan test at $P \leq 0.05$

2) The means of different year-harvest stage combinations with the same lower case are not statistically significant different from each other according to the Duncan test at $P \leq 0.05$

3) The means of different treatment-harvest stage combinations with the same lower case are not statistically significant different from each other according to the Duncan test at $P \leq 0.05$

The experimental design was randomized complete block in a split-plot design with four replications. The mixture-ratios and cutting-times are allocated as main plots and sub-plots, respectively.

Berseem clover cv. Derya (BC) and Italian ryegrass cv. Goardion (IR) were used as plant materials. Each plot was consisted of 14 rows with 25 cm inter-row spacing. Seed mixture ratios tested were sole crops of BC and IR, 80 per cent BC + 20 per cent IR, 60 per cent +BC 40 per cent IR, 40 per cent BC+ 60 per cent IR, 20 per cent BC + 80 per cent IR. Plots were fertilized with 50 kg ha⁻¹ N and 50 kg ha⁻¹ P₂O₅ as base fertilizer prior to sowing. Sowing was done by hand on first week of November in both of two years.

At harvesting applied at flowering start, 50 per cent flowering or full flowering of BC, one edge row from each side of plot were cut out and then rest of the plot was harvested and weighed to determine fresh forage yield. Rate of legumes and cereals in the mixture was calculated for each plot by separating and weighing each of the mixture components. In order to determine dry matter yield, a random sample of 500 g fresh forage was collected from each plot, weighed, and dried for 48 h in a air dryer at 70 °C. Enough fresh plant material from each plot was taken and chopped at 0.5-1 cm dimensions and sealed tight in 5 liter volumed silage containers and matured for 60 days. Silage was made on the basis of the rates in the botanical composition. Sample

Table 3: Dry Matter Yields of Pure Sowings and Mixtures of Berseem Clover and Italian Ryegrass, and Crude Protein Contents of Silages from Them.

Treatment	Harvest Stage	Dry Matter Yield (kg ha ⁻¹)			Crude Protein Ratio (%)		
		2012	2013	Mean	2012	2013	Mean
Sole BC	H1	8.4	9.0	8.7 g	11.65	12.11	11.88 a ³
	H2	10.6	9.3	9.9 ef	11.67	12.26	11.96 a
	H3	9.9	8.9	9.4 fg	7.59	10.55	9.07 f-h
Mean		9.6 c-e¹	9.0 e	9.3 C*	10.30 bc	11.64 a	10.97 A*
80BC-20 G	H1	9.4	8.7	9.1 g	11.67	11.38	11. ab53
	H2	10.9	8.9	9.9 ef	9.71	11.68	10.69 cd
	H3	10.3	10.3	10.3 de	6.92	9.61	8.27 ij
Mean		10.2 bc	9.3 de	9.8 BC	9.44 d	10.89 b	10.16 B
60BC-40 G	H1	8.7	10.1	9.4 fg	9.97	11.73	10.85 bc
	H2	10.1	8.2	9.2 fg	12.34	10.31	11.33 a-c
	H3	13.5	10.1	11.8 a	8.98	8.31	8.65 g-h
Mean		10.8 ab	9.5 de	10.2 AB	10.43 bc	10.12 c	10.27 B
40 BC-60G	H1	9.3	9.0	9.2 fg	9.02	9.11	9.07 f-h
	H2	12.0	10.6	11.3 ab	10.44	8.86	9.65 ef
	H3	11.1	10.4	10.7 b-d	8.27	8.48	8. 38 h-j
Mean		10.8 ab	10.0 cd	10.4 A	9.24 d	8.82 d	9.03 C
20BC-80 G	H1	7.8	10.3	9.1 g	11.45	8.53	9.99 d-e
	H2	10.4	12.4	11.4 ab	9.36	10.11	8.74 g-i
	H3	9.2	11.2	10.2 de	6.38	7.23	6.81 k
Mean		9.1 e	11.3 a	10.2 AB	9.06 d	7.95 e	8.51 D
Sole Grass	H1	7.9	9.5	8.7 g	10.17	8.36	9.27 e-g
	H2	9.7	11.3	10.5 c-e	9.13	8.26	8.70 g-i
	H3	10.2	12.0	11.1 bc	8.46	7.15	7.81 j
Mean		9.2 e	11.0 a	10.1 AB	9.26 d	7.92 e	8.59 D
Mean (Year)		9.9	10.0		9.62	9.56	
Harvest Stage Means							
	H1	8.6 d ²	9.5 c	9.0 B*	10.66 a	10.20 bc	10.43 A*
	H2	10.6 a	10.1 b	10.4 A	10.44 ab	9.91 c	10.18 A
	H3	10.7 a	10.5 a	10.6 A	7.77 e	8.55 d	8.16 B
	CV (%)		8.2			7.01	

*) The means with the same capital letter in the same column are not statistically significant different from each other according to the Duncan test at P≤0.05

1) The means of different year-treatment combinations with the same lower case are not statistically significant different from each other according to the Duncan test at P≤0.05

2) The means of different year-harvest stage combinations with the same lower case are not statistically significant different from each other according to the Duncan test at P≤0.05

3) The means of different treatment-harvest stage combinations with the same lower case are not statistically significant different from each other according to the Duncan test at P≤0.05

from each matured silage (500 g) was dried at 70 °C during 48 h, ground to 1 mm screen in a mill for quality analysis. Crude protein content was estimated by multiplying total N by 6.25 using Kjeldahl method. The content of acid detergent fiber (ADF) and neutral detergent fiber (NDF) were determined according to the methods of Van Soest (1982). Digestibility of dry matter (DDM), dry matter intake (DMI), and relative feed value (RFV) were determined by method of Jaranyama ve Garcia (2004) using the formulae: DDM= $88.9 - (0.779 \times \text{ADF} \%)$, DMI= $(\% \text{ of BW}) = 120 / (\text{NDF} \%)$, RFV=(DDM x DMI)/1.29. The pH values of silage samples were measured as reported by Chen *et al.* (1994).

Data were analysed using the JMP statistical analysis programme, and differences were compared using Duncan's multiple range test.

RESULTS AND DISCUSSION

Botanical composition: In the both years of experiment, BC ratio of dry matter yield of mixtures generally decreased while seed ratio of BC in the seed mixture decreased (Table 2). This result coincided with that of Kusvuran *et al.* (2014). Decreasing BC ratio with the decreasing seed ratio is an expected result. However contribution percentage of BC to mixture dry matter yield was generally lower than the percentage of BC in the seed mixture. From this results, it

Table 4: Neutral Detergent Fiber and Acid Detergent Fiber Contents of Silages from Pure Sowings and Mixtures of Berseem Clover and Italian Ryegrass.

Treatment	Harvest Stage	Neutral Detergent Fiber (%)			Acid Detergent Fiber (%)		
		2012	2013	Mean	2012	2013	Mean
Sole BC	H1	53.67	48.31	50.99	47.65	48.32	47.99 a
	H2	47.08	47.17	47.13	38.86	37.84	38.35 e
	H3	58.42	59.12	58.77	41.09	48.43	44.76 a-d
Mean		53.08 b-d¹	51.54 cd	52.30 B*	42.53	44.86	43.70
80BC-20 G	H1	47.44	47.36	47.40	45.17	40.26	42.72 b-e
	H2	53.40	48.31	50.86	42.58	38.65	40.62 de
	H3	62.47	55.82	59.15	39.49	47.81	43.65 a-d
Mean		54.44 bc	50.50 d	52.47 B	42.42	42.24	42.33
60BC-40 G	H1	52.35	49.10	50.73	42.30	38.40	40.35 de
	H2	52.74	53.99	53.37	45.37	42.50	43.94 a-d
	H3	55.70	61.19	58.45	40.27	47.59	43.93 a-d
Mean		53.60 b-d	54.76 bc	54.18 B	42.65	42.83	42.74
40 BC-60G	H1	54.59	55.50	55.04	46.00	46.72	46.36 ab
	H2	50.33	61.30	55.82	46.00	43.29	44.64 a-d
	H3	56.50	67.87	62.18	40.88	47.41	44.14 a-d
Mean		53.80 bc	61.56 a	57.68 A	44.29	45.80	45.05
20BC-80 G	H1	44.74	58.96	51.85	40.06	47.36	43.71 a-d
	H2	50.00	64.18	57.09	39.62	41.92	40.77 c-e
	H3	60.11	66.85	63.48	44.77	41.11	45.94 a-c
Mean		51.62 cd	63.33 a	57.48 A	41.48	45.46	43.47
Sole grass	H1	54.31	55.82	55.07	43.12	41.98	42.55 b-e
	H2	56.60	61.00	58.80	42.12	40.64	41.38 b-e
	H3	57.88	69.80	63.84	42.19	47.75	44.97 a-d
Mean		56.26 b	62.21 a	59.24 A	42.48	43.46	42.97
Mean (year)		53.80 B+	57.31 A		42.64	44.11	
Harvest Stage Means							
H1		51.18	52.51	51.85 C*	44.05 b ²	43.84 b	43.95 A*
H2		51.69	55.99	53.84 B	42.43 bc	40.81 c	41.62 B
H3		58.52	63.44	60.98 A	41.45 bc	47.68 a	44.57 A
CV (%)			6.29			8.64	

*) The means with the same capital letter in the same column are not statistically significant different from each other according to the Duncan test at $P \leq 0.05$

+) The means with the same capital letter in the same row are not statistically significant different from each other according

1) The means of different year-treatment combinations with the same lower case are not statistically significant different from each other according to the Duncan test at $P \leq 0.05$

2) The means of different year-harvest stage combinations with the same lower case are not statistically significant different from each other according to the Duncan test at $P \leq 0.05$

3) The means of different treatment-harvest stage combinations with the same lower case are not statistically significant different from each other according to the Duncan test at $P \leq 0.05$

could be said that IR can better compete with BC. Legumes are often less competitive than cereal or grass species as reported that BC yield reduced about 50 per cent when grown with oat (Holland and Brummer, 1999).

Dry matter (DM) yield: Seed mixtures of BC containing above 40 per cent IR were superior based on DM yield (Table 3) in the first year, but in the second year the mixture containing 80 per cent IR has higher yield than other mixtures. In some other researches, green herbage and DM yield decreased also by increasing seed rate of legume in the mixture (Kusvuran *et al.*, 2014). However, Karakurt and Ekiz (1996) reported that the highest dry matter yield was obtained from 80 per cent BC-20% IR (4.49 t ha⁻¹). Total precipitation (587 mm) in the second year of the experiment was lower than that (861.6 mm) in the first year (Table 1). Better benefiting IR from limited precipitation through the

shallow roots than the BC with the deep roots could be reason for the higher dry matter production of pure sowing IR and the seed mixtures containing higher IR. Thus, Shultz and Hayes (1938) determined that grasses were generally more resistant to drought than legumes. Mixtures gave higher dry matter yields than pure croppings in both years in accordance with result of El Kramany *et al.* (2012).

Crude protein ratio of silage: Lowering seed ratio of BC in the mixture generally decreased the crude protein (CP) ratio of silage (Table 3). Our results were in agreement with other studies (Carpici, 2017; Acar *et al.*, 2017) where legumes also increased CP concentrations when in mixture with cereals. In this respect, grass-legume mixtures have high crude protein concentration and low fiber concentration than pure grass stand. Legumes are good source of protein and can be used to compensate cereal protein shortage

Table 5: pH Values and Dry Matter Intake Ratios of Silages from Pure Sowings and Mixtures of Berseem Clover and Italian Ryegrass.

Treatment	Harvest Stage	pH			Dry Matter Intake (%)		
		2012	2013	Mean	2012	2013	Mean
Sole BC	H1	4.22	4.78	4.50	2.40	2.49	2.44
	H2	4.30	4.46	4.38	2.55	2.55	2.55
	H3	4.20	4.35	4.78	2.06	2.05	2.05
Mean		4.57	4.53	4.55	2.34 a-c¹	2.36 ab	2.35 A*
80 BC-20 G	H1	4.30	4.63	4.46	2.53	2.54	2.54
	H2	4.17	4.36	4.26	2.26	2.49	2.38
	H3	5.11	4.58	4.84	1.92	2.15	2.04
Mean		4.53	4.52	4.52	2.24 b-d	2.39 a	2.32 AB
60 BC-40 G	H1	4.26	4.52	4.39	2.29	2.46	2.38
	H2	4.31	4.59	4.45	2.32	2.22	2.27
	H3	4.91	4.31	4.61	2.16	1.97	2.06
Mean		4.49	4.48	4.48	2.26 b-d	2.22 cd	2.24 B
40 BC-60 G	H1	4.26	5.06	4.66	2.20	2.17	2.19
	H2	4.27	4.66	4.47	2.39	1.96	2.17
	H3	5.30	4.22	4.76	2.13	1.77	1.95
Mean		4.61	4.65	4.63	2.24 b-d	1.97 e	2.10 CD
20 BC-80 G	H1	4.20	5.04	4.62	2.70	2.04	2.37
	H2	4.22	4.49	4.35	2.40	1.87	2.14
	H3	5.13	4.05	4.59	2.00	1.80	1.90
Mean		4.52	4.53	4.52	2.38 ab	1.90 e	2.13 C
Sole Grass	H1	4.13	4.86	4.49	2.21	2.16	2.19
	H2	4.22	5.05	4.63	2.13	1.97	2.05
	H3	5.22	4.34	4.78	2.07	1.72	1.90
Mean		4.52	4.75	4.63	2.14 d	1.95 e	2.04 D
Mean (year)		4.54	4.58		2.26 A	2.13 B	
Harvest Stage Means							
H1		4.23 d ²	4.81 b	4.52 B*	2.39	2.31	2.35 A*
H2		4.25 d	4.60 c	4.23 B	2.34	2.18	2.26 B
H3		5.14 a	4.31 d	4.73 A	2.06	1.91	1.98 C
CV (%)			6.08			7.95	

*) The means with the same capital letter in the same column are not statistically significant different from each other according to the Duncan test at P≤0.05

1) The means of different year-treatment combinations with the same lower case are not statistically significant different from each other according to the Duncan test at P≤0.05

2) The means of different year-harvest stage combinations with the same lower case are not statistically significant different from each other according to the Duncan test at P≤0.05

(Gebrehiwot *et al.*, 1996). Differences between leaf and stem digestibility are normally greater in forage legumes than cereals (Buxton, 1996). Later harvest after 50 per cent flowering of BC resulted in the decreased CP ratio of silage. It is well known that delays in harvest stages of forage crops reduce crude protein content.

Neutral detergent fiber (NDF) content of silage: Mean NDF content of silage in the second year of experiment was significantly higher than that in the first year (Table 4). Rapid aging of the plants and higher contribution of IR to the dry matter yield of the mixtures due to lower precipitation in the second year could be reason of the higher NDF content of silage in that year. NDF content of grasses is generally higher

than legumes. Delaying the harvest from flowering start to full flowering of BC increased NDF content of silage. Matured plants usually possess increased fiber and lignin (Linn and Martin, 1999). The NDF content is important in ration formulation because it reflects the amount of forage that can be consumed by animals (Eskandari *et al.*, 2009).

Acid detergent fiber (ADF) content of silage: For both years, no significant differences are observed between different mixture and harvest applications in terms of ADF values, except harvest stage of second year (Table 4). Higher ADF ratio of silage harvested at full flowering of BC in the second year could be due to the higher IR ratio of the herbage. ADF is the percentage of highly indigestible plant material

Table 6: Relative Feed Values and Digestibility Dry Matter Ratios of Silages from Pure Sowings and Mixtures of Berseem Clover and Italian Ryegrass.

Treatment	Harvest Stage	Relative Feed Value			Digestible Dry Matter Ratio (%)		
		2012	2013	Mean	2012	2013	Mean
Sole BC	H1	102.7	98.8	100.8 b-d ³	55.36	51.26	53.31
	H2	116.2	117.3	116.8 a	58.63	59.42	59.02
	H3	90.8	81.9	86.4 e-h	56.89	51.17	54.05
Mean		103.3 ab¹	99.4 a-c	101.3 A*	56.96	53.95	55.46
80BC-20 G	H1	105.5	113.4	109.4 ab	53.71	57.54	55.62
	H2	97.6	113.3	105.5 a-c	55.73	58.79	57.26
	H3	86.8	86.1	86.5 e-h	58.14	51.66	54.90
Mean		96.6 a-c	104.3 a	100.5 A	55.86	55.99	55.93
60BC-40 G	H1	99.5	112.3	106.0 a-c	55.95	58.99	57.47
	H2	96.4	96.3	96.4 c-e	53.55	55.79	54.67
	H3	96.4	79.3	87.8 e-h	57.53	51.82	54.68
Mean		97.4 a-c	95.9 bc	96.7 AB	55.68	55.53	55.61
40BC-60 G	H1	90.6	88.8	89.7 d-h	53.07	52.51	52.79
	H2	98.2	83.7	90.9 d-g	53.07	55.18	54.12
	H3	94.1	71.3	82.7 f-h	57.05	51.97	54.51
Mean		94.3 c	81.3 d	87.8 C	54.40	53.22	53.81
20BC-80 G	H1	121.2	82.0	101.7 b-d	57.70	52.00	54.85
	H2	108.1	81.6	94.8 c-f	58.04	56.25	57.14
	H3	83.7	72.9	78.3 h	54.02	52.20	53.11
Mean		104.3 a	78.8 d	91.6 BC	56.59	53.48	55.03
Sole Grass	H1	94.9	94.2	94.5 c-f	55.31	56.20	55.75
	H2	92.5	87.3	89.9 d-h	56.09	57.24	56.67
	H3	90.0	69.0	79.5 gh	56.03	51.70	53.87
Mean		92.5 c	83.5 d	88.0 C	55.81	55.05	55.43
Mean (year)		98.1 A+	90.5 B		55.88 A+	54.54 B	
Harvest Stage Means							
H1		102.4	98.3	100.3 a	55.18 ab ²	54.75 b	54.97 B*
H2		101.5	96.6	99.0 a	55.85 ab	57.11 a	56.48 A
H3		90.3	76.7	83.5 b	56.61 ab	51.75 c	54.18 B
CV (%)			9.49			5.40	

*) The means with the same capital letter in the same column are not statistically significant different from each other according to the Duncan test at $P \leq 0.05$

+) The means with the same capital letter in the same row are not statistically significant different from each other according

1) The means of different year-treatment combinations with the same lower case are not statistically significant different from each other according to the Duncan test at $P \leq 0.05$

2) The means of different year-harvest stage combinations with the same lower case are not statistically significant different from each other according to the Duncan test at $P \leq 0.05$

3) The means of different treatment-harvest stage combinations with the same lower case are not statistically significant different from each other according to the Duncan test at $P \leq 0.05$

present in forage comprising cellulose, lignin and silica. Low ADF values means higher energy value and digestibility. Since lignin and silica are not digestible by ruminants, low ADF values are preferred. Also, the difference in the amount of NDF and ADF is an estimate of the hemicellulose in feed (Rebole *et al.*, 1996).

pH value of silage: pH value of the silage was influenced by only harvest time. As harvest stage delayed, pH has increased (Table 5). Xie *et al.* (2012) reported that lactic acid content of wheat silage decreased with the maturity of silage material. Bal (2006) determined that pH value of maize silage increased with the maturity of silage maize. These results are in agreement with our result.

Dry matter intake (DMI) ratio of silage: Mean dry matter intake ratio of silage in the first year was significantly higher than that in the second year (Table 5). Dry matter intake ratio of silage is negatively correlated with NDF content of silage as seen from the formula for the calculation of DMI ratio given in the material and method. Dry matter intake ratio of silage in the first year was higher due to lower NDF content of silage in the first year (Table 4). Generally, reducing the seed ratio of BC increased the DMI ratio of silage. Higher NDF content of IR silage as compared to BC silage resulted in lower DMI ratio of the silages with higher IR. Delaying harvest time from flowering start to full flowering of BC steadily decreased the DMI ratio of silage. This result was an expected result because NDF content of silage steady increased with the delaying the harvest time (Table 4).

REFERENCES

- Acar, Z., Gulumser, E., Asci, O.O., Basaran, U., Mut, H., Ayan, I. (2017). Effects of sowing ratio and harvest periods on hay yields, quality and competitive characteristics of Hungarian vetch – cereal mixtures. *Legume Research*, **40**(4) : 677-683.
- Anonymous, (2017). <https://mgm.gov.tr/eng/forecast-cities.aspx>
- Bal, M.A. (2006). Effects of hybrid type, stage of maturity, and fermentation length on whole plant corn silage quality. *Turkish Journal Veterian Animal Science*, **30**:331-336
- Buxton, D.R. (1996). Quality-related characteristics of forage as influenced by plant environment and agronomic factors. *Animal Feed Science and Technology*, **53**:37-49.
- Caballero, R., Arauzo, M., Hernaiz, P. J. (1994). Response to N-fertilizer of Italian ryegrass grown alone and in mixture with berseem clover under continental irrigated Mediterranean conditions. *Fertiliser Research*, **39**:105-112.
- Carpici, E.B. (2017). Determination of forage yield and quality of mixtures of hairy vetch with some cereals (oat, barley and wheat) grown as catch crop. *Legume Research*, **40** (6): 1088-1092.
- Chen, J., Stokes, M.R., Wallace, C.R. (1994). Effects of enzyme-inoculant systems on preservation and nutritive value of hay crop and maize silages. *Journal Dairy Science*, **77**: 501-512.
- El Kramany, M.F., Elewa, T.A., Bakry, A.B. (2012). Effect of mixture rates on forage mixture of Egyptian clover (*Trifolium alexandrinum* L.) with triticale (*X Triticosecale* Wittmack) under newly reclaimed sandy soil. *Australian Journal of Basic and Applied Sciences*, **6** (5): 40-44.
- Eskandari, H., Ghanbari-Bonjar, A., Galavai, M., Salari, M. (2009). Forage quality of cowpea (*Vigna sinensis*) intercropped with corn (*Zea mays*) as affected by nutrient uptake and light interception. *Notulae Botanicae Horti Agrobotanici Cluj-Napoca*, **37** (1):171-174.
- Foley, R.C., Bath, D.L., Dickinson, F.N., Tucker, H. A. (1972). *Dairy cattle: Principles, Practices, Problems, Profits*. Lea & Febiger, Philadelphia, PA.
- Gebrehiwot, L., McGrowand, R.L., Assefu, G. (1996). Forage yield and quality profile of three annual legumes in the tropical highlands of Ethiopia. *Journal of Agriculture*, **73**:83-98.
- Hall, D.D., Cromwell, G.L., Stahly, T.S. (1991). Effects of dietary calcium, phosphorus, calcium:phosphorus ratio and vitamin K on performance, bone strength and blood clotting status of pigs. *Journal of Animal Science*, **69**:646-655.

Digestible dry matter (DDM) ratio of silage: Mean DDM ratio of silage in the first year was significantly higher than that in the second year (Table 6). DDM ratio of silage is negatively correlated with ADF content of silage as seen from the formula for the calculation of DDM ratio given in the material and method. Therefore significantly changing of DDM ratio of silage depending on the year was in agreement with the changing the ADF content of silage depending on the year. On the other hand, effect of harvest time on the DDM ratio of silage was also in agreement with the effect of harvest time on the ADF content of the silage.

Relative feed value (RFV) of silage: Mean RFV of silage in the first year was significantly higher than that in the second year (Table 6). RFV is positively correlated with DMI and DDM ratio. Changing RFV of silage depending on the year coincides with the changing DMI and DDM ratio of silage depending on the years. Decreasing the seed ratio of BC 40 per cent or lower than 40 per cent in the mixture resulted in significantly reducing the RFV of silage. This result was an expected one because DMI, being positively correlated with RFV, showed the same trend with the decreasing the seed ratio of BC. Changing RFV of silage depending on the harvest time also coincided with the changing DMI and DDM ratio of silage depending on the harvest time.

CONCLUSION

The results of the study showed that the seed mixture of 60 BC-40 IR and harvest at full flowering stage of BC was superior based on DM yield and selected quality parameters.

- Holland, J.B. and Brummer E.C.(1999). Cultivar effects on oat-berseem clover intercrops. *Agronomy Journal*, **91**:321-329.
- Jaranyama, P. and Garcia, A.D. (2004). Understanding relative feed value (RFV) and relative forage quality (RFQ). College of Agric and Biological Sci, South Dakota State University, USDA.
- Karakurt E. and Ekiz, H. (1996). İskenderiye üçgülü (*Trifolium alexandrinum* L.) ile *Lolium multyflorum* lam) karışım oranlarının ot verimine etkisi. *Tarla Bitkileri Merkez Araştırma Enstitüsü Dergisi*, **5** (2): 25-30.
- Kusvuran, A., Kaplan, M., Nazli, R.I. (2014). Intercropping of Hungarian vetch (*Vicia pannonica* Crantz.) and barley (*Hordeum vulgare* L.) under different plant varieties and mixture rates. *Legume Research*, **37**: 590-599.
- Lawes, D.A. and Jones, D.I.H. (1971). Yield, nutritive value and ensiling characteristics of whole-crop spring cereals. *Journal Agriculture Science*, **76**:479-485.
- Linn, J.G. and Martin, P. (1999). Forage Quality and Interpretions. <http://www.extension>.
- Martiniello, P., De Santis, G., Iannucci, A. (1996). Effect of phenological stages on plant dry matter partitioning and seed production in berseem (*Trifolium alexandrinum* L.). *J. Agronomy Crop Science*, **177**: 39-48.
- Rebole, A., Trevinoand, J., Caballero, R. (1996). Chemical change associated with the field drying of oat forage. *Field Crops Research*, **47**:221-226.
- Robinson, R.C. (1969). Annual legume:cereal mixtures for forage and seed. *Agronomy Journal*, **61**:759-761.
- Shultz, H.K. and Hayes, H.K. (1938). Artificial drought tests of some hay and pasture grasses and legumes in sod and seedling stages of growth. *Journal of the American Society of Agronomy*, 676-682.
- Singh, V., Joshi, Y.P., Verma, S.S. (1989). Studies on the productivity of Egyptian clover and oats under intercropping. *Experimental Agriculture*, **25** (04): 541-544.
- Van Soest, P.J. (1982). Analytical systems for evaluation of feeds. **In**: Van Soest, PJ (Ed.), Nutritional Ecology of the Ruminant. Maizeell University, Ithaca, NY, pp. 75-94.
- Yucel, C., Avci, M., İnal, İ., Akkaya, M.R. (2016,) Researches of Berseem Clover (*Trifolium alexandrinum* L.) Breeding. Republic of Turkey Ministry of Food, Agriculture and Livestock, GDARP- Final Report.
- Xie, Z., Zhang, T., Chen, X., Li, G., Zhang, J. (2012). Effects of maturity stages on the nutritive composition and silage quality of whole crop wheat. *Asian Australas Journal Animal Science*, **25**:1374-1380.