Legume Research, 42(5) 2019: 680-683
Print ISSN:0250-5371 / Online ISSN:0976-0571

AGRICULTURAL RESEARCH COMMUNICATION CENTRE
www.arccjournals.com

A Study on the Silage Properties of Hungarian Vetch (*Vicia pannonica* Crantz.) and Barley (*Hordeum vulgare* L.) Grass Mixtures in Different Rates

G. Bengisu*

Harran University, Faculty of Agriculture,
Department of Field Crops, Sanliurfa, Turkey.
Received: 14-04-2019 Accepted: 11-08-2019 DOI: 10.18805/LR-494

ABSTRACT

This study was carried out in Harran University of Turkey during 2017-2018 in November-May growing season in order to investigate the effect of sole and mixed Hungarian vetch and Barley grass silage properties. In the study, 100% Hungarian vetch (H), 100% barley (B), "75% H + 25% B", "50% H + 50% B", "25% H + 75% B" mixtures were used. When the physical properties of silages were examined, it is observed that the silage quality increased as the barley ratio in the mixture increased, where the highest quality was obtained at sole barley silage. In terms of chemical properties of silages; the lowest acid detergent insoluble fiber (ADF) and neutral detergent insoluble fiber (NDF) and the highest protein content values were obtained from the "75% H + 25% B" silage mixture. It was concluded that the most suitable silage mixture for high silage quality was "75% H + 25% B".

Key words: Hungarian vetch, Barley, Silage quality, Protein, Mixture systems.

INTRODUCTION

Forage crops can be grown in a mixture and can be used as green grass, dry grass, for grazing or silage making (Doğan, 2010). In general, the mixture ratio should be adjusted well to obtain good quality feed with legume-cereal mixtures. Due to their physiology, addition of cereal crops in the mixture changes by the mixing ratios at sowing. This addition increases feed yield but reduces crude protein (CP) ration and CP yield (Uzun and Asik, 2009). In addition, it was shown that the use of cereals- which are poor in mineral content- in mixture with legumes is more suitable to combine the fast growth and high yield potential of cereals with the balanced feed content of the legumes.

Demirel *et al*. (2010) were mixed legumes and cereals in different proportions and reported that, in barley-white clover silage mixture, the CP content increased as the ratio of white clover in the mixture increased. Aykan and Saruhan (2018) mixed different ratios of forage pea and barley and reported that the highest score was obtained from sole barley silage where ADF and NDF of sole forage pea silage was lower than sole barley silage. Yücel *et al*. (2018a) mixed Italian grass and berseem clover and informed that they observed the most appropriate silage quality values were obtained with 60% Italian grass + 40% berseem clover mixture. Seydosoglu and Gelir (2019) informed that, in the silage of barley-grass pea mixture, silage pH value increased with the higher inclusion of grass pea in the mixture.

The aim of this research was to investigate some physical and chemical properties of silage made from Hungarian vetch (*Vicia pannonica* Crantz.) and Barley (*Hordeum vulgare* L.) used sole or mixed in different rates.

MATERIALS AND METHODS

In the research, Hungarian vetch (*Vicia pannonica* Crantz.) cv Sarıefe and Barley (*Hordeum vulgare* L) cv Sancak used as materials.

The research was carried out in Harran University Faculty of Agriculture in 2017-2018 during November-May period with 4 replications according to the randomized block design. Each parcel was 3 m long, with 6 rows and 20 cm row spacing. Hungarian vetch and barley were grown as sole. As starter fertilizer, diammonium phosphate fertilizer was applied to the parcels at rate of 40 kg / ha pure nitrogen and 100 kg / ha pure phosphorus (Kır *et al*. 2018). 100 kg / ha Hungarian vetch seed and 220 kg / ha barley seed was used for sowing.

Hungarian vetch and barley were harvested during flowering period and spike period, respectively. Harvested plant materials were transported to the warehouse as in bundles. Plant materials were kept in the shade for 3-4 hours in order to provide the necessary moisture content for ideal silage preperation. All green plants were then chopped at 0.5-1 cm in size with a silage chopper working with the tail shaft of a tractor. After the chopping process, the Hungarian vetch and barley plant materials were weighed in different amounts (Sole Hungarian vetch, sole barley, "%75 H + %25 B", "%50 H + %50 B", "%25 H + %75 B") in total 5 kg and

*Corresponding author's e-mail:gbengisu@hotmail.com
Harran University, Faculty of Agriculture, Department of Field Crops, Sanliurfa, Turkey.

filled in glass jars. A total of 20 glass containers were filled with four replications. Material were compressed firmly in accordance with Petterson, (1988)'s consecutive filling technique. To provide air isolation, hot silicone applied to the inner part of caps, then cans were closed tightly where 2-3 rounds thick tape was streched. Jars were allowed to fermentation for 45 days in dark environment (Petterson, 1988). At the end of this maturation period, jars were opened, the top 4-5 cm of silage were disposed and remaining silage materials were used for analyses.

Physical observations: After the jars were opened, subjective physical analyzes were performed on the samples consisting of color (0-2 points), structure (0-4 points) and odor (0-14 points) determinations. Samples were examined by 10 experts and then the average scores of these data were calculated (Table 1). The scoring method developed by the German Agricultural Organization (DLG) was used in the evaluation of physical analyzes (Akyıldız, 1984; Ergün *et al*. 2013). Then Flieg points of silages were determined by using the following formula (1) using dry matter and pH values obtained in the laboratory.

Fleig Point = 220+ (2 x %Dry matter -15)-40 x pH (1)

Chemical processes: In order to measure the pH of the silages, samples were taken from the aqueous parts from the bottom of the glass jars which is then mixed by a blender and then the pH of the liquid was measured by digital pH meter (Anonymous, 1993). 500 g of silage samples were taken from each jar as representative of the sample which then pre-dried at 70 ^{0}C for 24 hours in the drying cabinet and the silage dry matter ratio was calculated (Bulgurlu and Ergül, 1978). After standing in the drying cabinet for fixing the dry materials of the samples, milling was done. Crude ash, CP content, ADF, NDF and lactic acid ratio were determined by Weender Analysis method, Kjendahl method, Ankom fiber method, Ankom fiber method and HPLC method, respectively. Digestible dry matter (DDM), dry matter consumption (DMC) and relative feed value (RFV) were calculated by the following equations (2-4) (Morrison, 2003).

DDM= 88.9-(0.779 x %ADF) (2)
DMC= 120 / %NDF (3)
RFV= (DDM x DMC) / 1.29 (4)

The variance analyzes of the data obtained from the study were conducted by using JUMP statistical package program based on randomised complete block design and the significant averages were grouped based on LSD, 5% (Kalaycı, 2005).

RESULTS AND DISCUSSION

The values of physical observations (color, odor, structure), their scores and quality classes of the silage samples obtained by mixing the Hungarian vetch with barley in sole and different proportions are given in Table 1. Considering the total points; the highest (19.00 points) and the lowest (14.50 points) value were obtained from "100% B" and "100% H" silage, respectively.The results obtained in terms of physical properties were found to be similar to the studies of many researchers (Altınok, 2002; Yılmaz *et al*., 2007; Demirel *et al*., 2010; Aykan and Saruhan, 2018; Seydosoglu and Gelir, 2019).

It is determined that the silage pH value is important in Hungarian vetch and barley mixtures in pure and in different ratios. Silage pH value was reached to the highest value (4.13) at "100% B" and lowest value (3.82) at "25% H + 75% B" silage mixture. As the amount of barley in the mixture was increased, the silage pH value was decreased. Parallel to our findings, increasing amount of barley in the

Table 1: Physical properties, scoring and quality classes of silages.

Mixing ratios	Color (point)	Structure (point)	Odour (point)	Total (point)	Quality Class
%100 H	2.00	3.00	9.50	14.50	Good
%100 B	1.50	3.50	14.00	19.00	Very Good
%75 H + %25 B	1.75	3.00	11.00	15.75	Good
%50 H + %50 B	1.75	4.00	11.00	16.75	Good
%25 H + %75 B	2.00	3.00	12.50	17.50	Good

Table 2: Chemical properties of silages.

Mixing ratios	pH	DDM (%)	Ash (%)	CP (%)	Flieg (point)
%100 H	4.00c	27.40e	8.30	18.58a	99.90d
%100 A	4.13a	33.48a	8.76	11.75e	106.65c
%75 H + %25 B	4.02b	28.85d	8.41	16.28b	102.00d
%50 H + %50 B	3.90d	30.15c	8.36	15.08c	109.20b
%25 H + %75 B	3.82e	32.18b	8.50	13.45d	116.65a
Average	3.97	30.41	8.47	15.03	106.88
Coefficient of variance (%)	0.18	2.24	1.65	1.93	1.27
LSD(0.05)	0.03**	2.29**	n.s.	2.31**	4.56**

mixture of silage resulted with pH reduction similar to other studies like Demirel *et al*., (2010); Aykan and Saruhan, (2018); Seydosoglu, (2019); Seydosoglu and Gelir, (2019). Silage pH value is one of the most important factor affecting the silage fermentation. It is reported that the optimum pH range is 3.8-4.2 for the development of lactic acid bacteries, and the silage degradation and decaying bacteria cannot survive within this pH range (Ergün *et al*., 2013). According to the results obtained, as explained above, there was no negative observation on silage quality (degradation, decay etc.).

In terms of dry matter rate; the highest (32.48%) and the lowest (27.40%) ratio were obtained from "100% B" and "100% H" silage, respectively. Parallel to our findings, increasing amount of barley in the mixture of silage resulted with increases in dry matter content similar to other studies like Demirel *et al*., (2010) and Seydosoglu and Gelir, (2019).

There was an inverse relationship between silage pH value and dry matter value. As the amount of Hungarian vetch in the mixture increased, there was a slight increase in the pH, while the dry matter value was decreased. This was due to the low fermentable carbohydrate content required for the fermentation by lactic acid bacteria and the high content of CP in the silo environment due to the conversion of proteins to ammonia during fermentation (Kılıç, 1986).

The effect of crude ash ratio on different mixtures of Hungarian vetch and barley in silage was not statistically significant. The average crude ash content was found to be 8.47%.

The rate of CP was found to be significant in pure and different proportions of Hungarian vetch and barley mixtures (Table 3), where increasing rates of Hungarian vetch in the mixture resulted with increased CP rate. The highest (18.58%) and the lowest (11,75%) silage CP value was obtained from "100% H" and "100% B" silage, respectively. It was determined that the ratio of CP increased as the ratio of legume in the mixture increased. This is due to the high protein content of legumes. Many investigators also reported an increase in CP as a result of the increase in legume ratio in mixtures. Parallel to our findings, increasing amount of legumes in the mixture of silage resulted with increases in CP content in studies like that of Yücel *et al*., (2018a) and Seydosoglu and Gelir, (2019).

Flieg score was statistically significant. The highest (116.65) and the lowest flieg score (99.90) was obtained from the "25% H + 75% B" and "100% H" silage, respectively. As the barley content was increased, the fleig score was also increased. All flieg points obtained from the research were over 100. This was due to the ideal pH and dry matter ratio of silages (İptaş and Avcıoğlu, 1996).

The highest ADF ratio was obtained from 100% B silage, while the lowest ADF were obtained both from "100% H" and "75% H + 25% B" silage mixtures. Parallel to our findings, Pereira-Crespo *et al*. (2010) found in their studies that ADF value was low in sole feed peas and high in sole triticale.

The effect of NDF ratio on the sole and different proportions of Hungarian vetch and Barley mixtures were statistically significant. The highest rate (55.65%) of NDF and the lowest rate (46.33%) of NDF ratio were obtained from "100% B" and "100% H" silages, respectively. Similar to ADF ratio, as the ratio of barley in the mixture increased, the NDF ratio was increased. This result is similar to findings of Carr *et al*. (2004) who observed higher NDF values in cereals than in feed peas. Since the rate of digestible dry matter was determined with the help of ADF ratio, the difference in the proportion of ADF in sole and mixtures of silages was effective in differentiating DDMR rates (Table 3). The highest DDMR ratio was obtained both from "% 100 H" and "75% H + 25% B" mixture silage from the same group where the lowest was obtained from "100% B" silage.

Parallel to our findings, Yılmaz *et al*., (2014) measured DDMR of the silage of Hungarian vetch-barley mixtures in their study between 60.7-64.4%.

When Table 3 is examined, since the rate of DMC is determined as a factor depending on the rate of NDF, the change in NDF ratios was led to changes in DMC ratios. The highest and lowest DMC ratio was obtained from "100% H" and "100% B" silage, respectively. The effect of RFV on mixtures was found to be statistically significant.The highest (130.04%) and the lowest (103.00%) RFV value were

Table 3: Some features examined in the research.

Mixtures	ADF (%)	NDF (%)	DDMR (%)	DMC (%)	RFV	LA (%)
%100 H	31.03d	46.33e	64.73a	2.59a	130.04a	2.01d
%100 B	35.03a	55.65a	61.62d	2.16e	103.00e	2.12a
%75 H + %25 B	31.18d	48.63d	64.61a	2.47b	123.62b	2.04c
%50 H + %50 B	32.83c	50.68c	63.33b	2.37c	116.27c	2.07b
%25 H + %75 B	33.95b	52.40b	62.45c	2.29d	110.87d	2.10ab
Average	32.80	50.74	63.35	2.37	116.76	2.07
CV	2.1	1.28	0.84	1.27	1.8	0.49
LSD(0.05)	2.3**	2.19**	1.78**	0.11**	7.01**	0.06**

DDMR: Digestable Dry Matter Content; DMC: Dry matter consumption; RFV: Relative Feed Value; LA: Lactic acid.

obtained from “100% H” and “100% B” silage, respectively (Table 3). According to quality classification of Rohweder *et al*. (1978),it can be concluded that the sole and mixtures obtained in our study were at good quality level.

It can be seen that lactic acid ratio was important. The highest rate of lactic acid was obtained from “100% B” and “25% H + 75% B” mixture silage where the lowest was obtained from “100% H” silage. It was reported by many investigators that lactic acid ratio should be above 2% in a good quality silage (Kılıç, 1986; Geren and Kavut, 2009; Seydosoglu and Saruhan, 2017).

CONCLUSION

In terms of physical properties of silages; quality was increased with increasing rate of barley in the mixture, where the highest quality class was obtained from sole barley silage. In terms of the chemical properties of silages, the best pH and dry matter rate value were obtained from “25% H + 75% B”and “100% B” silage, respectively. While the most appropirate CP, ADF, NDF, DDM, DMC and RFV values were obtained from sole Hungarian vetch silage but sole barley was best for lactic acid ratio. In terms of all features, it was concluded that 75% H + 25% B silage is more suitable.

REFERENCES

Altınok S.(2002). Farklı Karışım Oranlarındaki Arpa, Koca Fiğ ve Tüylü Fiğin Silaj Kalite Özelliklerinin Belirlenmesi Üzerine Bir Araştırma. *Tarım Bilimleri Dergisi*. **8** (3): 232237.

Anonymous.(1993). Bestimmung des pH-Wertes. In: Die chemischen Untersuchungen von Futtermitteln. Teil 18 Silage. Abschnit 18.1 Bestimmung des pH-Wertes. Methodenbuch Bd. III., VDLUFAV Verlag, Darmstadt.

Akyıldız, A.R.(1984). Yemler Bilgisi Laboratuvar Kılavuzu. *Ankara Üniversitesi Ziraat Fakültesi Yayınları*. **893**: 213, Ankara.

Aykan, Y., Saruhan, V. (2018). Farklı Oranlarda Silolanan Yembezelyesi (*Pisum sativum* L.) ve Arpa (Hordeum vulgare L.) Karışıımlarının Silaj Kalite Özelliklerinin Belirlenmesi, *Dicle Üniversitesi Veteriner Fakültesi Dergisi*. **11**(2):64-70.

Bulgurlu Ş, Ergül M.(1978). Yemlerin Fiziksel, Kimyasal ve Biyolojik Analiz Metotları. *E Ü. Basımevi*, Yayın No: **127**, İzmir. 176s.

Carr, P.M., Horsley, R.D., Poland, W.W.(2004). Barley, oat and cereal–pea mixtures as dryland forages ın the Northern Great Plains. *Agronomy Journal*. **96**(3): 677–684

Comberg, G.(1974). Gärfutter: Betriebswirtschaft, Erzeugung, Verfütterung, Verlag Eugen Ulmer Stuttgart, Gerokstraße 19, Printed in Germany, ISBN:3-8001-4321-6, 260s

Doğan, S. (2010). Van koşullarında yem bezelyesi (*Pisum arvense* L.) ve arpa (*Hordeum vulgare* L.) karışımlarının ot verimi ve silaj kalitesine etkisi. *Yüzüncü Yıl Üniversitesi Fen Bilimleri Enstitüsü YLT*. 37s.

Demirel, R., Saruhan, V., Baran, M.S., Andiç, N., Demirel, D.Ş. (2010). Farklı Karışım Oranlardaki Ak Üçgül Ve Arpanın Silolanma Özelliklerinin Tespit Edilmesi. *Yüzüncü Yıl Üniversitesi Tarım Bilimleri Dergisi*. **20** (1): 26-31.

Ergün, A., Tuncer, Ş.D., Çolpan, Yalçın, S., Saçaklı, P. (2013). Yemler, Yem Hijyeni ve Teknolojisi. *Ankara Üniversitesi Veteriner Fakültesi* Genişletilmiş 5. Baskı, Ankara.

Geren, H., Kavut, Y.T. (2009). İkinci Ürün Koşullarında Yetiştirilen Bazı Sorgum (Sorghum spp.) Türlerinin Mısır (Zea mays L.) ile Verim ve Silaj Kalitesi Yönünden Karşılaştırılması Üzerine Bir Araştırma, *Ege Üniversitesi Ziraat Fakültesi Dergisi*. **46**(1): 9-16.

Kılıç, A. (1986). Silo Yemi Öğretim, Öğrenim ve Uygulama Önerileri. *Bilgehan Basımevi*, İzmir.

Kalaycı, M.(2005). Örneklerle Jump Kullanımı ve Tarımsal Araştırma için Varyans Analizi Modelleri, *Anadolu Tarımsal Araştırma Enstitüsü Yayınları*, no:**21**

Morrison, J.A. (2003). Hay and pasture managment, chapter 8. extension educator, crop systems rock ford extension center. (http://iah.aces.uiuc.edu/pdf/Agronomy_HB/08chapter.pdf), (Access date: 19.11.2018).

İptaş, S., Avcıoğlu, R. (1996). Silajda Fermantasyon Ürünleri ile Nitelik Belirleme Yöntemleri Arasındaki ilişkiler. *Türkiye 3. Çayır-Mera Yem bitkileri Kongresi* 17-19 Haziran 1996, Erzurum. S: 775–781.

Petterson, K. (1988). Ensiling of Forages: Factors Affecting Silage Fermantation and Quality. *Swedish University of Agricultural Sciences, Department of Animal Nutrition and Management*, Uppsala, 46p.

Pereira-Crespo, S., Fernández-Lorenzo, B., Valladares, J., González-Arráez, A., Flores, G. (2010). Effects of seeding rates and harvest date on forage yield and nutritive value of pea-triticale intercropping. *Options Méditerranéennes, A*. (**92**): 215-218.

Rohweder, D.A., Barnes, R.F., Jorgensen, N. (1978). Proposed hay grading standards based on laboratory analyses for evaluating quality. *Journal of Animal Science*. **47**(3): 747-759.

Seydosoglu, S. (2019). Effects of different mixture ratios of grass pea (*Lathyrus sativus* L.) and barley (*Hordeum vulgare*) on quality of silage. *Legume Research*, DOI:10.18805/LR-468 (in press).

Seydosoglu, S., Gelir, G. (2019). Farklı Oranlarda Karıştırılan Mürdümük (*Lathrus sativus* L.) ve Arpa (*Hordeum vulgare* L.) Hâsıllarının Silaj Özellikleri Üzerinde Bir Araştırma, *Iğdır Üniversitesi Fen Bilimleri Enstitüsü Dergisi*. **9**(1): 397-406.

Seydosoglu, S., Saruhan, V. (2017). Mısır Bitkisinde (Zea mays L.) Ekim Zamanı ve Çeşidin Silaj Kalitesi Üzerine Etkisi, *Ege Üniversitesi Ziraat Fakültesi Dergisi*. **54** (3):361-366.

Uzun, A., Aşık, F.F. (2009). Bezelye+yulaf karışımında farklı karışım oranları ile biçim zamanlarının otun verimi ve kalitesi üzerine etkisi. *Türkiye 8. Tarla Bitkileri Kongresi*, 19-22 Ekim, Hatay, 584–588.

Yılmaz, Ş., Şanverdi, M., Kaya, Ş. (2007). Silaj Sorgumxsudanotu Melezlerinde Ekim Zamanının Silaj Kalitesine Etkisi. *Türkiye VII. Tarla Bitkileri Kongresi*, 25-27 Haziran, 289292. Erzurum.

Yücel, C., Avcı, M., Yucel, H., Sevilmiş, U., Hatipoğlu, R. (2018a). Effects of seed mixture ratio and harvest time on forage yield and silage quality of intercropped berseem clover with triticale, *Fresenius Environmental Bulletin*. **27** (8): 5312-5322.

Yılmaz, Ş., Özel, A., Atak, M., Erayman, M. (2014). Effects of Seeding Rates on Competition İndices of Barley and Vetch İntercropping Systems in East Mediterranean. *Turkish Journal of Agriculture and Forestry*. **39**: 135–143.