Asian Journal of Crop Science

ISSN 1994-7879

science alert
http://www.scialert.net

ANSInet
an open access publisher
http://ansinet.com

Asian Journal of Crop Science 2 (1): 20-24, 2010
ISSN 1994-7879

Evaluation of Sunflower Silage in Different Developmental Stages

[1]E. Mafakher, [1]M. Meskarbashee, [1]P. Hassibi and [2]M.R. Mashayekhi
[1]Department of Agronomy, Faculty of Agriculture,
Shahid Chamran University, Ahvaz, Iran
[2]Scientific Board of Agriculture and Natural Resources Research Center,
Khuzestan Province, Iran

Abstract: This experiment was conducted in a complete randomized block design with three treatments and four replications. Dry and fresh forage yields, starch and head contribution of plant increased with maturity. The values of ash, crude protein, pH, *in vitro* dry matter digestibility and leaf contribution of plant were higher ($p<0.01$) in late of budding stage. The best harvest time for ensiling was late of blooming stage and before seed formation under spring condition.

Key words: Chemical composition, developmental stages, *in vitro* digestibility, sunflower silage

INTRODUCTION

Sunflower stand out as alternative for forage production and conservation as silage because its drought tolerance, high Dry matter yield, resistance to cold and heat, adaptability to different edafoclimatic conditions and its relative independence of latitude, altitude and photoperiod (Goncalves *et al*., 1999). Sunflower, in comparison to corn, provides high dry matter yield and has better resistance to both drought and cold (Goncalves *et al*., 1999). Also, its protein and inorganic nutrients is more than corn (McGuffey and Schingoethe, 1980). Therefore, application of sunflower forage in corn basis ration seems to be useful for improving livestock nutrients in ration. Palatability, nutrient composition and digestibility of ensiled plant materials is affected by maturity of crop when ensiled, water content of crop and proportion of ears or heads to stalks (Bal *et al*., 1997). To obtain a good quality and high nutritive values silage, the material should be cut at the right point of maturity (Edwards *et al*., 1978).

Determined chemical composition and nutritive value of sunflower, cv. Armavirec, at 12 stages of growth. Maximum yield of dry matter occurred at the dough seed stage and the optimum time of cutting for yield of nutrients obtained at the milky ripe stage. Goncalves *et al*. (1999) reported that the best harvest time of sunflower for ensiling varied according to genotype was 37 days after flowering for DK 180 and M734, more than 51 days for V2000 and about 30 days for Rambosol-91 varieties. Demirel *et al*. (2006b) observed that dry grass yield and table ration of sunflower green herbage increased from blooming stage to dough stage. Dry matter, organic matter and crude fat content were higher in sunflower silage that harvested at milk-dough seed stage. The highest lactic and propionic acid and the lowest butyric acid and pH values were observed in blooming stage silage. Tan and Tumer

Corresponding Author: Elahe Mafakher, Department of Agronomy, Faculty of Agriculture, University of Shahid Chamran, Ahvaz, Iran

(1996) ensiled sunflower at several stages of maturity and concluded that the final flowering stage was the best stage for silage making.

Studies are limited on the whole plant of sunflower harvested at varying stages of maturity for use as silage in Iran. The objective of this research was determine of dry matter yield, chemical composition and digestibility of sunflower harvested at three developmental stages.

MATERIALS AND METHODS

Sunflower crop (*Helianthus annus* L.) was planted in different planting date included Feb 26th, March 12th and March 26th, 2008 at Shahid Chamran University of Ahvaz (Iran). Sunflower cultivar was Euroflor that used at 130000 plants ha^{-1} in a complete randomized block design with four replications. Whole plants were hand harvested on May 22th in late of budding stage (R_3), late of flowering stage (R_5) and milk-dough seed stage (R_6-R_7) from 10 cm above soil level. All samples were harvested from the center of rows and then immediately weighed. Forage samples used for dry matter yield were forced air oven dried at 70°C. Also at same time (May 22th) plant materials at each stages chapped, wilting and ensiled as rapidly as possible in 2 L plastic jars. Then, plant materials was packed and compressed by hand. Sealed experimental silages were incubated at room temperature (20 to 23°C) for 45 days. After this time experimental silos were opened. Samples were dried at 70°C and data reported an oven-dry basis. Fifty grams of each samples was diluted 1:2 with distilled water, blended for 1 min and filtered through Whatman 54 paper and then measuring with a portable pH meter. Dry Matter (DM), Crude Protein (CP), Crude Fiber (CF) and Ash following the method of AOAC (1990) Water Soluble Sugar (WSS) and starch was determined according to Schlegl (1986). *In vitro* Dry Matter Digestibility (IVDMD) and *in vitro* Organic Matter Digestibility (IVOMD) was determined by the method of Tilley and Terry (1963). Data were analyzed by Statistical Analysis System (SAS Inst., 2003) to determine significant effects ($p<0.01$) .

RESULTS AND DISCUSSION

The highest forage yield and head ration were obtained at R6-R7 stage and these values increased with maturity. This results were also reported by Demirel *et al.* (2006b) and Edwards *et al.* (1978). The highest leaf ration and height were obtained at R3 stage. Height of plant decreased by maturity. arise from the head ration increase with maturity (Table 1). Which is in contrast with result published by Demirel *et al.* (2006b). This difference may be according to genotype varied. Mean dry matter contents increased with maturity but developmental stages had not significant differences (Table 2). In general, an increase in dry matter and organic matter contents is expected with maturity (Demirel *et al.*, 2006b). Crude protein was greater for R3 stage compared to other stages and had not significant differences among R5 and R6-R7 (Table 2). Many experiments reported similar results that crude protein content declined with increasing maturity (Lslam *et al.*, 2004; Harper *et al.*, 1981). This decline was related to decrease in leave/steam proportion in plant with maturity (Fig. 1, Table 1). Water soluble sugars of R5 stage was higher than other stages (Table 2).

Chemical composition of treatment silages are presented in Table 3. Dry matter of R5 stage silage was higher than of R3 and R6-R7 stages. The concentrations of crude protein and ash were significantly higher in R3 stage silage compared to other treatments and declined with increasing of maturity. This decline was related to the decline in the proportion

Table 1: Height of plant, forage yield and weight, moisture and proportion of shoot dry-matter in sunflower at different developmental stages

Developmental stages	Height (cm)	Fresh forage yield (t ha^{-1})	Dry forage yield (t ha^{-1})	Composition (%) Stem	Leaf	Head
R3	152.24a	100.45b	11.43b	48.387a	46.671a	4.942b
R5	137.41ab	147.58ab	18.37ab	48.852a	31.501b	19.647a
R6-R7	129.41b	187.42a	25.47a	44.308a	27.113b	28.579a
CV (%)	5.32	13.20	15.10	4.63	7.15	10.65

Developmental stages	Head (g)	Stem (g)	Leaf (g)	Moisture (%) Head	Stem	Leaf
R3	3.834c	39.543b	37.024a	87.877a	92.426a	80.877a
R5	23.992b	59.659ab	38.456a	92.626a	89.288ab	81.760a
R6-R7	50.209a	77.413a	47.441a	90.028a	87.494b	81.675a
CV (%)	24.41	15.07	19.31	3.83	2.15	3.37

Mean values in the same column followed by the same letter(s) are not significantly different at p<0.01 by ANOVA and Duncan multiple range tests

Table 2: Dry Matter (DM), Crude Protein (CP) and Water Soluble Sugar (WSS) in sunflower at different development stages

Development stages	DM (%)	CP (%)	WSS (mg g^{-1})
R3	11.35a	16.30a	95.34b
R5	12.51a	13.39b	116.50a
R6-R7	13.70a	12.46b	74.59c
CV (%)	4.81	3.28	4.38

Mean values in the same column followed by the same letter(s) are not significantly different at p<0.01 by ANOVA and Duncan multiple range tests

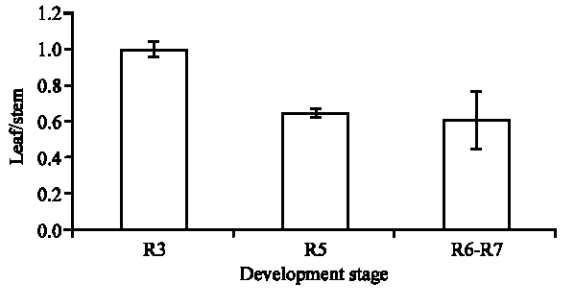

Fig. 1: Dry matter of leaf to steam Proportion in plant at different development stages. I, standard error of a mean

of leaf in whole plant (Table 1). There were not significantly different among silages crude fiber, although in R5 stage was greater than R6-R7 stages. It was reported that decreases in NDF content with maturation arise from the fact that seed ration increases and seed has lower cell wall components (Demirel *et al*., 2006b). Silage pH value was lower for R6-R7 stages and declined with increasing maturity. This result may be due to increase of concentration of water soluble sugars, Lactate and extensive fermentation with increasing maturity (Bal *et al*., 1997).

The effect of maturity on digestibility is shown in Table 3. *In vitro* organic matter digestibility was similar in treatments. *In vitro* Dry matter digestibility was similar in R3 and R5 stages silages and was lower in R6-R7 stage silage. The lower dry matter digestibility of R6-R7 stage may be due to the higher ether extract with seed formation (Valdez *et al*., 1988). On the other hand, starch and cell wall of feedstuffs have a great impact on digestibility (Demirel *et al*., 2006a). Therefore, this result is due to the higher content of starch (Fig. 2).

Table 3: Chemical composition, dry and organic matter digestibility (% DM) and pH of sunflower silage at different development stages

Development stages	pH	DM	Ash	CP	CF	IVDMD	IVOMD
R3	5.67a	27.91b	21.37a	15.12a	32.25a	69.93a	63.35a
R5	4.59b	32.97a	17.37b	13.06b	35.50a	69.18a	64.81a
R6-R7	4.30c	24.19c	16.50b	12.87b	32.75a	65.87b	62.72a
CV (%)	0.70	2.12	2.70	1.61	6.18	1.24	2.14

Mean values in the same column followed by the same letter(s) are not significantly different at $p<0.01$ by ANOVA and Duncan multiple range tests

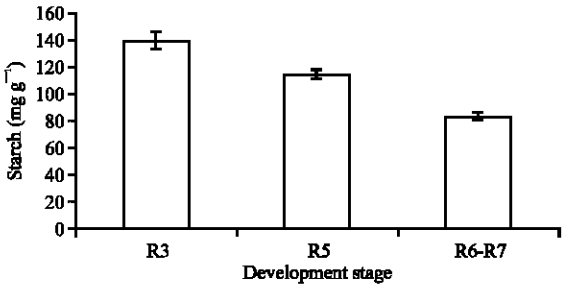

Fig. 2: Starch content of whole sunflower plant at different development stages. I, standard error of a mean

In conclusion, acceptable quantity and quality forage can be made from whole plant sunflower at R6-R7 stage. But because of decrease in dry matter digestibility, nutritive value and also stem bending and mechanize harvesting difficult, in this stage, R5 stage was optimum maturity stage for harvesting sunflower to use as silage, however, produced lower dry matter yield.

ACKNOWLEDGMENTS

We are thankful for the financial support provided by the Scientific Research Presidency of Shahid Chamran University. M.Sc. Thesis: 8833177 numbers. We are also thankful to the Jahad Agriculture Organization of Khuzestan Province for supplying the seed.

REFERENCES

AOAC, 1990. Official Methods of Analysis of the Association of Official Analytical Chemists. 13th Edn., Association of Official Analytical Chemist, Washington, DC., USA.

Bal, M.A., J.G. Coors and R.D. Shaver, 1997. Impact of the maturity of corn for use as silage in the diets of dairy cows on intake, digestion and milk production. J. Dairy Sci., 80: 2497-2503.

Demirel, M., D. Bolat, S. Celik, Y. Bakici and A. Tekeli, 2006a. Evaluation of fermentation qualities and digestibilities of silages made from sorghum and sunflower alone and the mixtures of sorghum-sunflower. J. Boil. Sci., 6: 926-930.

Demirel, M., D. Bolat, S. Celik, Y. Bakici and S. Celik, 2006b. Quality of silages from sunflower harvested at different vegetational stages. J. Applied Anim. Res., 30: 161-165.

Edwards, R.A. F. Harper, A.R. Henderson and E. Donaldson, 1978. The potential of sunflower as a crop for ensiling. J. Sci. Food Agric., 29: 332-338.

Gonçalves, L.C., N.M. Rodriguez, L.G.R. Pereira and J.A.S. Rodrigues, 1999. Evaluation of different harvest times of four genotypes of sunflower (*Helianthus annuus* L.) for ensiling. Proceedings of the FAO Electronic Conference on Tropical, (ECT'99), Silage, pp: 1-6.

Harper, F., E. Donaldson, A.R. Henderson and R.A. Edwards, 1981. The potential of sunflower as a crop for ensilage and zero-grazing in Northern Britain. J. Agric. Sci., 96: 45-53.

Lslam, M.R., M. Lshida, S. Ando, T. Nishida, N. Yoshida and M. Arakawa, 2004. Effect of variety and stage of maturity on nutritive value of whole crop rice, yield, botanical fractions, silage fermentability and chemical composition. Asian-Aust. J. Anim. Sci., 17: 183-192.

McGuffey, R.K and D.J. Schingoethe, 1980. Feeding value of high oil variety of sunflower as silage to lactating dairy cows. J. Dairy Sci., 63: 1109-1113.

SAS, 2003. SAS User's Guide: Statistics. Version 8.2, SAS Institute Inc., Cary, NC.

Schlegl, H.G., 1986. Die verwertung organgischer souren durch chlorella lincht. Planta, 47: 510-526.

Tan, A.S. and S. Tumer, 1996. Research on the evaluation of silage quality of sunflowers. Anadolu Abstr., 6: 45-57.

Tilley, J.M.A. and R.A. Terry, 1963. A two stage technique for the *in vitro* digestion of forage crops. J. Br. Grassland Sco., 18: 104-111.

Valdez, F.R., J.H. Harrison, D.A. Deetz and S.C. Fransen, 1988. *In vivo* digestibility of corn and sunflower intercropped as a silage crop. J. Dairy Sci., 71: 1860-1867.