

## A Comparison of Herbage and Protein Yields of Artificial Rangeland Forage Mixtures

Ömer Terziođlu and Bünyamin Yildirim  
Yüzüncü Yil University, Faculty of Agriculture, 65080 Van, Turkey

**Abstract:** This research was conducted on a farmer's field in Erci<sup>o</sup> (Van), Turkey in 2001 and 2002. Four forage plants-Garden Burnet, Sainfoin, Crested Wheatgrass and Sheep Fescue were used in the study. Six mixtures were prepared, each comprised of 25% crested wheatgrass and 25% sheep fescue, but with variations in sainfoin and garden burnet ratios of 0-50, 10-40, 20-30, 30-20, 40-10 and 50-0%. Study results found that the highest hay and crude protein yields (1111 and 180 kg ha<sup>-1</sup>, respectively) were obtained with the mixture consisting of 25% crested wheatgrass, 25% sheep fescue, 30% garden burnet and 20% sainfoin. This mixture rate can be recommended for use on artificial rangelands established in drought areas in semiarid regions throughout the world.

**Key words:** Herbage, protein, artificial, rangelands, forage mixtures, species

### INTRODUCTION

Rangelands in semiarid regions throughout the world have been witnessing a steady decrease in yield over time. In areas with sparse vegetation, erosion depredation increases while grazing opportunities for livestock decrease. The establishment of artificial rangelands represents one possible solution to these problems.

A number of forage species can be incorporated into plant mixtures suitable for use on artificial rangelands. Several suggestions have been put forward based on field research in this area. Sainfoin (*Onobrychis sativa* lam.), in particular, is a fast-emerging forage species that has been shown to adjust well with grasses such as crested wheatgrass (*Agropyron cristatum* L. Gaertn), smooth brome grass (*Bromus inermis* Leyss.), tall fescue (*Festuca arundinacea* Schreb.) and orchardgrass (*Dactylis glomerata* L.) in dry conditions (Altin, 1991; Açikgöz, 2001; Serin and Tan, 1996; Hoveland and Townsend, 1985). Sainfoin is also rich in protein and, according to the Institute of Grassland and Environmental Research (IGER) in Aberystwyth, can potentially reduce costs of feed concentrate by 20% when used as a supplement to grazed and ensiled grass (Anonymous, 1998).

Garden burnet has requirements similar to those of sainfoin (Gençkan, 1983) and may also be used as a component in artificial range mixtures along with crested wheatgrass (*Agropyron cristatum* L. Gaertn), intermediate wheatgrass (*A. Intermedium* Host. Beauv.) and tall fescue (*Festuca arundinacea* Schreb.) (Soya *et al.*, 1992;

Açikgöz, 2001). Garden burnet emerges naturally in Turkey in early spring (Davis, 1985) and may maintain greenness until the onset of winter. As a feed component, garden burnet resembles alfalfa (*Medicago sativa* L.), but does not cause bloat when freshly grazed (Soya *et al.*, 1992; Ipek and Sevimay, 2001).

Crested wheatgrass (*A. cristatum* L. Gaertn) and sheep fescue (*Festuca ovina* L.) are well adapted to semi-arid cold desert regions because of their cool-temperature growth and drought tolerance. Studies have shown them to be the best forage components in mixtures used on arid rangelands in Turkey (Gençkan, 1992; Chatterdon and Harrison, 2003; Asay and Knowles, 1985; Buckner, 1985; Açikgöz, 2001).

An earlier study found non-fertilized natural pasture in Van comprised primarily of grasses (86.0%) mixed with legumes (5.1%) and other plant material (8.9%) had a crude protein ratio of 8.05% (Terziođlu, 1995).

Yilmaz *et al.* (1999) found hay yields of heavily grazed and relatively light grazed ranges to be 630.8 and 1741.4 kg ha<sup>-1</sup>, respectively. Şakar *et al.* (2001) obtained hay yields of 383.0 and 1, 206 kg ha<sup>-1</sup> and green herbage yields of 1, 828.93 and 5, 757.3 kg ha<sup>-1</sup> on protected and grazed rangelands, respectively.

The mixture utilized in this study consists of 4 species prevalent on Turkey's rangelands and can be used in all parts of the country. The incorporation of species that emerge early and maintain their greenness longer can extend the grazing period of artificial rangelands.

**Table 1: The variations of plant mixture**

Mixture no.	Crested wheatgrass (%)	Sheep fescue (%)	Garden burnet (%)	Sainfoin (%)
1	25	25	10	40
2	25	25	20	30
3	25	25	30	20
4	25	25	40	10
5	25	25	50	0
6	25	25	0	50

**MATERIALS AND METHODS**

This research was conducted on a farmer’s field in the Erci<sup>o</sup> district of Van in 2001 and 2002. The experimental area has an arid climate and an average temperature of 7.9°C. According to long-term climate data, the average annual precipitation for the district is 458.0 mm; however, actual precipitation during the experimental years was 30% below average (Anonymous, 2002).

The experimental field consisted of a sand-pebble soil mixture with a pH of 7.5, average phosphorous content, abundant potassium and lime content and poor organic material content.

Experimental plant material consisted of sainfoin (*Onobrychis sativa* Lam.), garden burnet (*Sanguisorba minor* Scop.), crested wheatgrass (*Agropyron cristatum* L.) and sheep fescue (*Festuca ovina* L.). Initial fertilization with 20 kg da<sup>-1</sup> DAP was performed at sowing, after which no additional fertilizer was provided.

Six variations of plant mixture were utilized in the experiment, as shown in Table 1.

Planting was conducted on April 5, 2000 and harvesting took place during the first week of June in both 2001 and 2002.

A randomized design was utilized with 3 blocks divided into 20 m<sup>2</sup> (4×5 m) parcels. In each parcel, plants were sown in 12 rows 30 cm apart. The central 12 m<sup>2</sup> (3×4 m) of each parcel was harvested and data was recorded for herbage yields, hay yields, crude protein ratios and crude protein yields. Data was processed using the SAS software package and Duncan’s multiple comparison tests were used to group averages.

**RESULTS AND DISCUSSION**

**Herbage yields:** Herbage yields for 2001, 2002 and the average of the 2 years for each of the 6 mixtures tested are shown in Table 2.

Differences in herbage yields between years were not statistically significant (p<0.05); however, statistical differences were found in the 2-year average between mixtures, which varied between 1723 kg ha<sup>-1</sup> (Mixture 5) and 3897 kg ha<sup>-1</sup> (Mixture 3). Our study found yields lower than those of Şakar *et al.* (2001) for protected natural rangelands and light grazed rangelands, but higher than those of Yılmaz *et al.* (1999) for heavily grazed rangelands.

**Table 2: Herbage yields for forage mixtures with different plant ratios (kg ha<sup>-1</sup>)**

Mixture	2001	2002	2 year average
1	2797	3006	2901 bc
2	3013	3356	3185 b
3	3530	4265	3897 a
4	2887	2116	2502 c
5	1887	1560	1723 d
6	2387	2449	2413 c
Total	2750	2792	2771

\* Differences between values followed by the same letter are not significant (p<0.05)

**Table 3: Hay yields for forage mixtures with different plant ratios (kg ha<sup>-1</sup>)**

Mixture	2001	2002	2 year average
1	839	896	868 b
2	934	961	947 ab
3	977	1245	1111 a
4	703	584	644 c
5	507	429	468 c
6	632	667	649 c
Total	765	797	781

\* Differences between values followed by the same letter are not significant (p<0.05)

**Table 4: Crude protein ratios for forage mixtures with different plant ratios (%)**

Mixture	2001	2002	2 year average
1	21.3	15.9	18.7 ab
2	19.8	14.7	17.2 bc
3	18.4	14.4	16.4 cd
4	17.1	12.3	14.7 de
5	16.3	10.9	13.6 e
6	22.1	16.6	19.4 a
Total	19.2 a	14.1 b	16.7

\* Differences between values followed by the same letter are not significant (p<0.05)

**Hay yields:** Hay yields for 2001, 2002 and the average of the 2 years for each of the 6 mixtures tested are shown in Table 3.

Differences in hay yields between years were not statistically significant (p<0.05); however, statistically significant differences were found in the 2-year average between mixtures, which varied from 468 (Mixture 5) to 1111 kg ha<sup>-1</sup> (Mixture 3).

The yields obtained were lower than those of Yılmaz *et al.* (1999) for lightly grazed natural rangeland and higher than those of heavily grazed natural rangeland. They were also lower than the yields obtained by Şakar *et al.* (2001) for protected and grazed natural rangelands.

Differences in both herbage and hay yields between this study and the other studies mentioned may be due to differences in soil structure of the experimental plots and the low rainfall during the years our study was conducted.

**Crude protein ratios:** Crude protein ratios for 2001, 2002 and the average of the 2 years for each of the 6 mixtures tested are shown in Table 4.

Differences in crude protein ratios between years (2001, 19.2%; 2002, 14.1%) were statistically significant

Table 5: Crude protein yields for forage mixtures with different plant ratios (kg ha<sup>-1</sup>)

Mixture	2001	2002	2 year average
1	179	145	162 ab
2	186	142	164 ab
3	180	181	180 a
4	121	72	96 cd
5	84	49	66 d
6	139	112	125 bc
Total	148 a	117 b	132

\* Differences between values followed by the same letter are not significant (p<0.05)

(p<0.05). The higher crude protein ratio in 2001 may be due to the earlier emergence and growth of sainfoin and garden burnet in that year. Differences in the 2-year average crude protein ratios between mixtures were also statistically significant (p<0.05). Mixtures with higher ratios of sainfoin had higher 2-year average crude protein ratios, with Mixture 6 (50% sainfoin) having the highest (19.4%) of all the groups tested. The crude protein ratios for all 6 mixtures in our study were higher than the crude protein ratio of 8.05% reported by Terziođlu (1995) for a non-fertilized parcel of natural rangeland consisting of grasses (86.0%) mixed with legumes (5.1%) and other plant species (8.9%).

**Crude protein yield:** Crude protein yields for 2001, 2002 and the average of the 2 years for each of the 6 mixtures tested are shown in Table 5.

Differences in both crude protein yields between years and in the 2-year average yields between mixtures were statistically significant (p<0.05). The average for 2001 was 148 kg ha<sup>-1</sup> compared to 117 kg ha<sup>-1</sup> for 2002. The 2 year average yield varied from a low of 66 kg ha<sup>-1</sup> for Mixture 5 and a high of 180 kg ha<sup>-1</sup> for Mixture 3.

### CONCLUSION

Mixture 3, consisting of crested wheatgrass (25%), sheep fescue (25%), garden burnet (30%) and sainfoin (20%), had the highest hay yields as well as the highest crude protein yields. Therefore, of the 6 mixtures tested, this mixture is recommended for use in artificial rangelands in arid regions.

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