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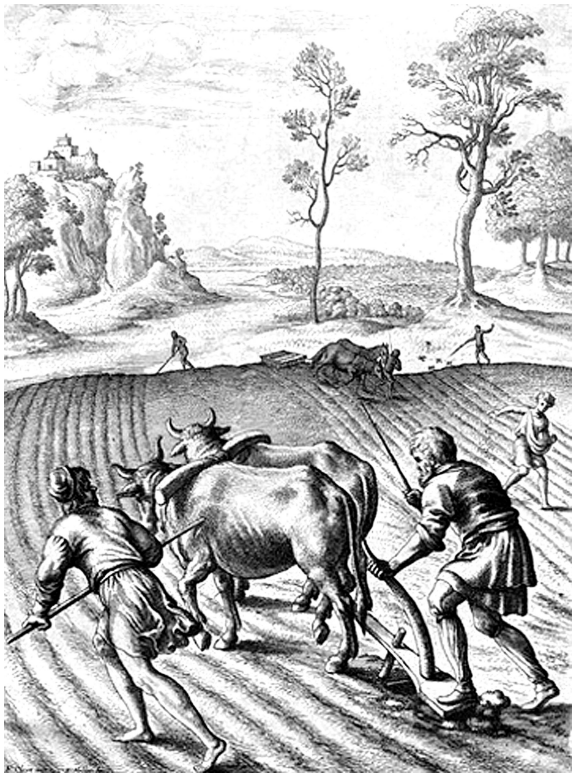

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# Investigation for the Determination of Red Clover (*Trifolium pratense* L.) Cultivars may Grown in Southeastern Anatolia Region of Turkey

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**Abstract:** In the present study, some agricultural characteristics were investigated on 6 red clover cultivars obtained from various resources, between 1999 and 2001, under irrigated conditions in Diyarbakir. The average values of the three years for red clover cultivars showed that the green herbage yield varied from 3615.9 to 4649.9 kg $da^{-1}$; dry herbage yield from 868.5 to 1254.2 kg $da^{-1}$; the height of the plants from 26.78 to 32.20 cm and their protein ratio from 15.82 to 17.43%. Among all the cultivars, D-282 had the highest herbage yield and plant height, followed by Colenso, G-27 and Pawera. The lowest herbage yield was obtained from D-259 and Turoa cultivars. The highest protein content was obtained from Turoa (17.43%) although there was no significant differences among the cultivars.

**Key words:** Red clover, *Trifolium pratense*, herbage yield, plant height, crude protein

## Introduction

Turkey has a huge potential owing to the existing 49,249,000 farm animals (sheep, goat, cow and buffalo) (Anonymous, 2001). However, the desired animal production can not be achieved. When the problem is dealt within terms of stock-raising, it is noticed that the animals are fed inadequately.

According to the latest data the cultivation area for barley, corn, vetch, millet and canary-grass is 4.750.000 ha in Turkey and the crops obtained from those lands is 19,125,070 tons (Anonymous, 2001). Contrary to the animal existence of Turkey there forage crops production amount has been inadequate. Therefore, it has become indispensable to increase the rate of forage crops in field culture so that the animal production desired can be attained.

In forage crops culture, the choice of species is one of the most important elements in order to be able to reach high yield. Now-a-days there are a variety of species adapted to different climatic conditions throughout the world. Therefore, in order to meet the need for forage crops that is required for this region, it is necessary that studies into species, yield and adaptation for quality red clover suitable for the area should be carried out and determined.

Tukel ***et al.*** (1992) obtained 3186-8230 kg $da^{-1}$ green herbage yield, 840-1737 kg $da^{-1}$ dry herbage yield and 31.8-48.1 cm plant height in the study conducted with 18 red clover cultivars under irrigated condition in Harran Plain of Turkey. Polat and Tukel (1993) obtained 8072-14006 kg $da^{-1}$ green herbage yield, 1872-3924 kg $da^{-1}$ dry herbage yield and 41.0-54.3 cm plant height, as a result of the 4 cutting in one year, on the 15 red clover cultivars in Cukurova Region of Turkey. Wheaton (1993) obtained the green herbage yield of red clover cultivars between 652-778 kg $da^{-1}$ and the crude protein ratio over 14-15% in Colombia-USA.

Silbir ***et al.*** (1994) obtained 5149-5493 kg $da^{-1}$ green herbage yield, 1338-1428 kg $da^{-1}$ dry herbage yield and 23.5-40.7 cm plant height on the 3 red clover cultivars in Harran Plain.

Serin ***et al.*** (1998) obtained the dry herbage yield of red clover on an average 1203 kg $da^{-1}$ and the crude protein ratio 17.49% in Erzurum (in Tukey). The present study therefore, tried to determine the most suitable red clover species to be grown under irrigated conditions in Southeastern Anatolia Region of Turkey.

## Materials and Methods

Six red clover cultivars were used during this study. Among these red clover cultivars; Grasslands Colenso, Tetraploid G-27, Grasslands Pawera and Grasslands Turoa were obtained from Margot Forde Forage Germplasm Centre (New Zealand), D-282 and Naturel Tetraploidy D-259 were obtained from Southeastern Anatolia Agricultural Research Institute (Diyarbakir).

This research work was carried out in the Department of Field Crops, Faculty of Agriculture, Dicle University, Diyarbakir. The altitude of the research location is 660 m and it is located on $37^{o}$ 54' North latitude and $40^{o}$ 14' East longitude.

Generally, Mediterranean and East Anatolian continental climate are effective in this region. In The Southeastern Anatolia of Turkey, the average annual temperature is 15.8, rainfall is 481.6 mm and the average relative humidity is about 53.8%. The average temperature can increase up to 30°C in July and August. The lowest temperature can be 7°C in December and January. The early frost in the region is usually at the end of October and the last frost is until 24th of April.

An important portion of the annual rainfall is in winter; however, there is almost no rainfall between July and September. The highest values of humidity (70%) appear in winter. The lowest relative humidity values are in summer and may decrease up to 27%.

Total amount of rainfall of the years 1999 and 2000 (260.2 and 382.8 mm) were lower than the average of long years while the total rainfall amount of 2001 (605.2 mm) was higher than average of the long years. There was not an important difference between the years of experiment and long years average in terms of average heat (Table 1).

The soil of the experimental area, is deep or half deep zonal soil having ABC profile on the flat or near-flat slopes. There is plenty amount of calcium in the profile. In terms of soil structure,

Table 1: Average air temperatures (°C), the amount of rainfall (mm) and relative air moistures of the research area

| | Average of Air Temperature (°C) | | | | Rainfall (Mm) | | | | Relative Air Moisture (%) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Months | 1999 | 2000 | 2001 | Long Term | 1999 | 2000 | 2001 | Long Term | 1999 | 2000 | 2001 | Long Term |
| January | 4.5 | 1.3 | 4.0 | 1.7 | 15.6 | 70.9 | 14.9 | 73.5 | 71 | 74 | 68 | 76 |
| February | 5.3 | 2.5 | 5.0 | 3.5 | 45.5 | 58.2 | 72.4 | 67.1 | 67 | 64 | 66 | 72 |
| March | 8.1 | 7.0 | 11.4 | 8.1 | 52.0 | 30.7 | 126.1 | 67.9 | 65 | 51 | 69 | 65 |
| April | 13.6 | 15.3 | 14.3 | 13.8 | 76.1 | 33.0 | 54.0 | 70.5 | 64 | 57 | 64 | 63 |
| May | 21.0 | 20.5 | 16.7 | 19.3 | 22.4 | 6.1 | 86.9 | 42.1 | 43 | 37 | 60 | 56 |
| June | 27.3 | 28.0 | 26.7 | 25.9 | 1.1 | 0.3 | 0.0 | 7.0 | 31 | 21 | 26 | 37 |
| July | 31.4 | 33.4 | 31.6 | 31.0 | 0.9 | 0.0 | 0.0 | 0.7 | 26 | 13 | 22 | 27 |
| August | 30.6 | 30.4 | 30.2 | 30.3 | 0.0 | 0.0 | 0.0 | 0.5 | 27 | 20 | 25 | 27 |
| September | 24.4 | 24.7 | 24.7 | 24.8 | 10.5 | 0.9 | 0.0 | 2.7 | 37 | 27 | 27 | 32 |
| October | 17.6 | 16.7 | 16.3 | 17.0 | 2.7 | 35.1 | 67.0 | 31.1 | 43 | 47 | 50 | 48 |
| November | 9.8 | 9.4 | 7.0 | 9.6 | 1.9 | 34.0 | 52.2 | 54.0 | 41 | 54 | 60 | 67 |
| December | 4.8 | 4.3 | 5.1 | 4.1 | 31.5 | 113.6 | 131.7 | 71.5 | 66 | 79 | 61 | 76 |
| Mean/Total | 16.5 | 16.1 | 16.1 | 15 | 260 | 382 | 605 | 481.6 | 48 | 45 | 49 | 53 |

Source : Data from Diyarbakir Meteorological Directorate

the basic material is thin structured alluvial material or limestone. The soil with low organic material and phosphorus, consists of high clay content (49-67%) in 0-150 cm profile. Also, the salt rate is suitable for cultivating plants, and the water permeability of the soil is good (Anonymous, 1997).

Seeding rate in this trial was 5 kg $ha^{-1}$. In 6 rows on each plot and 20 cm far from each other and 5 m in length. Planting was made manually on the lines marked by a hand-marker on 12.05.1999. The experimental area was fertilized with 40 kg nitrogen (N) and 102 kg phosphorus ($P_2O_5$) $ha^{-1}$ before planting.

The trial was irrigated by sprinkler. Because of the climate, the irrigating intervals were between 7-12 days and irrigation period was 8 h on average (h=7.86 mm/h). Except rainfalls, annually 1250 mm water was given to the trial. The highest rate of the water consumption occurred in July and August.

According to Hughes ***et al.*** (1966) cuttings were made at the full bloom period of cultivars. Before cutting, the mean plant height was obtained from randomly selected 10 plants by averaging the distance from soil level to the highest point at the top.

The dry herbage percentage of the green herbage samples, were determined by randomly taking 0.5 kg green herbage from each plot and drying it in the greenhouse, obtained percentage was multiplied by the yield of the green herbage to find out the dry herbage yield.

For the protein analysis, the herbage samples (with stalks and leaves) which were taken from each plot through the year, were grounded and at the end of a season and mixed equally and

the sample taken from this mixture was used in the protein analysis. The crude protein ratio was determined with Leco FP-528 protein analyzer. Analysis of variance was done by using MSTAT-C statistical package and differences were compared with LSD tests.

## Results and Discussion

### Green herbage yield

The differences between red clover cultivars with respect to the green herbage yield were found significant for each two years and average of the these years (Table 2).

All red clover cultivars that were examined in a season total green herbage yield in first year is low but in second and third years were increased step by step.

The average green herbage yield were 1307.4, 4159.5, 7300.2 kg $da^{-1}$ in 1999, 2000 and 2001, respectively and the three years average value was 4255.7 kg $da^{-1}$. The reason why low yield in the first year was may be due to the root growth and the short growing period in the first year.

The green herbage yields varied from 872.2 to 1961.1 kg $da^{-1}$ in 1999. While the highest green herbage yield were obtained from D-259 and Pawera cultivars, the lowest yield values were obtained from Colenso, Turoa and D-282.

The green herbage yields varied from 3550.6 to 5302.6 kg $da^{-1}$ in 2000. While the highest green herbage yield obtained from D-282, the lowest yield values were obtained from other cultivars.

The green herbage yields varied from 6424.9 to 8025.1 kg $da^{-1}$ in 2001. While the highest green herbage yield were obtained from Colenso, the lowest yield values were obtained from Turoa.

According to the average values of the three years, the green herbage yields varied from 3615.9 to 4649.9 kg $da^{-1}$. While the highest green herbage yield were obtained from D-282, G-27 Colenso, Pawera and D-259 cultivars, respectively and the lowest yield value was obtained from only Turoa (Table 2).

Our findings related to green herbage yield of the red clovers were in agreement with Tukel ***et al.*** (1992) and Silbir ***et al.*** (1994) but they were lower than Polat and Tukel (1993) and higher than Wheaton (1993). This difference may be due to the different cultivars and different ecological conditions from their study.

### Dry herbage yield

Significant differences were observed between red clover cultivars with respect to the dry herbage yield during the study period (Table 3).

The average dry herbage yield were 312.8, 1175.5, 1700.5 kg $da^{-1}$ in 1999, 2000 and 2001, respectively and the three years average value was 1062.9 kg $da^{-1}$. The reason yield in first year may be due to the root growth and the short growing period.

Table 2: Average green herbage yields (kg da$^{-1}$) of red clover cultivars

| Cultivars | 1999 | 2000 | 2001 | Average |
|---|---|---|---|---|
| Colenso | 885.2c | 4260.7b | 8025.1 | 4390.4a |
| G-27 | 1392.1bc | 4038.3b | 7745.0 | 4391.8a |
| Pawera | 1636.9ab | 4230.3b | 6951.8 | 4273.0a |
| Turoa | 872.2c | 3550.6b | 6424.9 | 3615.9b |
| D-282 | 1096.7c | 5302.6a | 7550.6 | 4649.9a |
| D-259 | 1961.1a | 3574.7b | 7103.6 | 4213.1ab |
| Average | 1307 | 4159 | 7300 | 4255 |
| L.S.D (%5) | 523.4 | 811.5 | NS | 629.1 |
| C.V. (%) | 26.56 | 12.94 | 15.89 | 17.98 |

Table 3: Average dry herbage yields (kg da$^{-1}$) of red clover cultivars

| Cultivars | 1999 | 2000 | 2001 | Average |
|---|---|---|---|---|
| Colenso | 235.8c | 1232.2b | 1986.5a | 1151.5ab |
| G-27 | 356.8ab | 1112.8bc | 1833.3ab | 1101.0b |
| Pawera | 434.7a | 1171.0bc | 1654.4abc | 1086.7b |
| Turoa | 221.7c | 976.5c | 1548.7bc | 915.6c |
| D-282 | 346.3ab | 1554.2a | 1862.1ab | 1254.2a |
| D-259 | 281.5bc | 1006.2c | 1317.7c | 868.5c |
| Average | 312 | 1175 | 1700 | 1062 |
| L.S.D (%5) | 108.7 | 219.7 | 346.5 | 133.7 |
| C.V. (%) | 23.05 | 12.40 | 13.52 | 15.30 |

Table 4: Average plant height (cm) of red clover cultivars during the study period

| Cultivars | 1999 | 2000 | 2001 | Average |
|---|---|---|---|---|
| Colenso | 25.19b | 30.29b | 33.50a | 29.66b |
| G-27 | 24.45b | 27.01c | 28.89b | 26.78c |
| Pawera | 26.36ab | 28.10c | 25.98b | 26.81c |
| Turoa | 18.72c | 20.51d | 19.86c | 19.70d |
| D-282 | 28.02a | 34.51a | 34.06a | 32.20a |
| D-259 | 25.75b | 33.52a | 27.14b | 28.80b |
| Average | 24.75 | 28.99 | 28.24 | 27.33 |
| L.S.D (%5) | 2.196 | 2.107 | 4.413 | 1.689 |
| C.V. (%) | 5.89 | 4.82 | 10.37 | 7.51 |

*Means having same letter in the same column are non-significantly different (P< 0.05),

NS= non-significant

Table 5: Average crude protein (%) and the groups emerged among different cultivars of the red clover

| Cultivars | 1999 | 2000 | 2001 | Average |
|---|---|---|---|---|
| Colenso | 18.22 | 14.45c | 16.42 | 16.36 |
| G-27 | 15.65 | 15.42bc | 17.22 | 16.10 |
| Pawera | 15.30 | 15.86bc | 16.84 | 16.00 |
| Turoa | 17.43 | 17.56a | 17.29 | 17.43 |
| D-282 | 15.26 | 16.16ab | 16.02 | 15.82 |
| D-259 | 16.34 | 15.42bc | 18.65 | 16.80 |
| Average | 16.37 | 15.81 | 17.07 | 16.42 |
| L.S.D (%5) | NS | 1.598 | NS | NS |
| C.V. (%) | 10.41 | 6.70 | 8.73 | 8.79 |

*Means having same letter in the same column are non-significantly different (P< 0.05),

NS= non-significant

The dry herbage yields varied from 221.7 to 434.7 kg $da^{-1}$ in 1999. While the highest dry herbage yield were obtained from Pawera, G-27 and D-282, respectively and the lowest yield values were obtained from Turoa and Colenso.

The dry herbage yields varied from 976.5 to 1554.2 kg $da^{-1}$ in 2000. While the highest dry herbage yield were obtained from D-282, the lowest yield values were obtained from Turoa and D-259. The dry herbage yields varied from 1317.7 to 1986.5 kg $da^{-1}$ in 2001. While the highest dry herbage yield were obtained from Colenso, D-282, G-27 and Pawera, respectively, the lowest yield values were obtained from D-259. According to the average values of the three years, the dry herbage yields varied from 868.5 to 1254.2 kg $da^{-1}$. While the highest dry herbage yield were obtained from D-282 and Colenso, the lowest yield value was obtained from D-259 and Turoa (Table 3). Our findings related to dry herbage yield of the red clovers were in agreement with Tukel ***et al.*** (1992) and Silbir ***et al.*** (1994) and Serin ***et al.*** (1998).

**Plant height**

There were significant differences w observed among red clover cultivars with respect to plant height for each year and average of the three years. The average plant height were 24.75, 28.99, 28.24 cm in 1999, 2000 and 2001, respectively and the three years average value was 27.33 cm. The plant heights varied from 18.72 to 28.02 cm in 1999. While the highest plant height were obtained from D-282 and Pawera, the lowest yield value was obtained from Turoa. The plant heights varied from 20.51 to 34.51 cm in 2000. While the highest plant heights were obtained from D-282 and D-259, the lowest yield value was obtained from Turoa.

The plant heights varied from 19.86 to 34.06 cm in 2001. While the highest plant heights were obtained from D-282 and Colenso, the lowest yield value was obtained from Turoa. According to the average values of the three years, the plant heights varied from 26.78 to 32.20 cm. While the highest plant height was obtained from D-282, the lowest values were obtained from G-27 and Pawera (Table 4). Our findings related to dry herbage yield of the red clovers were in agreement with Silbir ***et al.*** (1994) but lower than Tukel ***et al.*** (1992) and Polat and Tukel (1993). This differences was possibly due to the different cultivars and different ecological conditions from their study.

**Crude protein**

Significant difference was observed between the red clover cultivars with regard to the crude protein ratio in the second year. However, non-significant differences were formed between 1st and 3rd years' rates and the 3 year's average values. The crude protein ratio were found as 16.37, 15.81, 17.07% in 2001, respectively and as 16.42% according to the average of the three years. The crude protein ratio varied from 15.26 to 18.22% in 1999, while the highest crude protein were obtained from Colenso, the lowest yield values were obtained from D-282. The crude protein ratio varied from 14.45 to 17.56% in 2000, while the highest crude protein ratio were obtained from Turoa and D-282, the lowest values were obtained from Colenso. The crude protein ratio varied from 16.02 to 18.65% in 2001, while the highest crude protein ratio were obtained from D-259, the lowest values were obtained from D-282. According to the average values of the three year, the crude protein ratio varied from 15.82 to 17.43%. While the highest crude protein ratio were obtained from Turoa, the lowest values were also obtained from D-282 (Table 5). D-282 and Colenso cultivars of red clover were adapted successfully to the region and showed superior performances than the other cultivars. It is concluded that these superior cultivars can be used for roughage production in irrigated conditions of the region. In addition, it is important to consider new studies with red clover cultivars as pure and as a mixtures with perennial forage grasses, and determination of available mixing rates and performance against grazing should also be studied.

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