



Determination of Yield and Quality Characteristics of Some Fodder Beet (*Beta vulgaris* L. var. *rapa*) Varieties in Sakarya Ecological Conditions

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ABSTRACT

This research; it was established under the Sakarya ecological conditions and carried out for 2 years between 2021 and 2023 to determine the yield and quality characteristics of some fodder beet varieties. The experiment was set up with four replications in a randomized blocks trial design. Rekord, Rota, Ursus and Zentaur varieties were used in this research. In the study; in tubers; length (cm), diameter (cm), aboveground length ratio (%), yield (kg/da), dry matter content (%), dry matter yield (kg/da), crude protein ratio (%), sugar ratio (%) and weight loss in storage (%) and in leaves; yield (kg/da), length (cm), width (cm), dry matter ratio (%), dry matter yield (kg/da) and crude protein ratio (%) properties were investigated. The most positive data in the study were obtained from the Ursus variety (In tuber: length; 29.1 cm, yield; 19.309 kg/da, dry matter content; 15.9%, crude protein ratio; 9.30%, sugar ratio; 6.35%, and in leaves; length; 61.0 cm, yield; 2.585 kg/da, dry matter content; 14.0%, crude protein ratio; 23.5%).

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Introduction

The nutrition of our Turkiye's animals is largely based on pasture. However, the productivity of the pastures is quite low due to excessive and uncontrolled grazing. For this reason, it is necessary to increase the production amounts of forage crops in field agriculture in order to reduce and improve the grazing pressure on pastures and to meet the required quality of forage.

Turkiye has a total area of 19.8 million hectares of field agriculture, of which 1.8 million hectares are cultivated with forage crops. Although the ratio of forage crops in field agriculture has increased in recent years, it is around 9%, and agriculture and animal husbandry are quite low compared to developed countries (Celik, 2013).

The annual roughage requirement of the Turkiye's livestock is 55 million tons. 10 million tons of this amount are tried to be met from pastures, 35 million tons from forage crop agriculture and the remaining 10 million tons from factory-produced mixed feeds (Celik, 2013). The main issue here is not the quantity but the quality of the

feed obtained from pastures and forage crops. When the situation is evaluated from this perspective, it is obvious that there is a deficit in quality roughage. Among the forage crops, the cultivation area of fodder beet is approximately 11.15 hectares (Anonymous, 2024). It is an important forage plant that can provide the highest yield per unit area and is rich in water. It is an important forage plant, especially for dairy farming; it increases the quality of milk, the fat and crude protein ratio, and saves concentrated feed. Because it is delicious, it is easily consumed by animals. Its digestibility level is high (87-93%). The rate of nutrients in dry matter is high. It provides more energy than other forage plants. Its leaves are also used in animal feeding and strengthen the digestive systems of animals (Acikgoz, 2021; Akyildiz, 1986; Anonymous, 2024; Ergul, 1988; Genckan, 1983).

Many researchers (Abou-Deya, 1991; Acar, 2000; Adiyaman, 2003; Albayrak & Yuksel, 2009; Anonymous, 2002; Avcioglu & Sabanci, 1993; Bartolomaeus, 1988;

Cristiansen-Weniger et. al., 1979; Cetin & Ozhan, 1992; Cetin, 1998; Elmali, 1998; Geren, 1996; Hofman et. al., 1970; Jankowiak et. al., 1988; Kampf et. al., 1985; Kokten & Ozdemir, 2020; Manga, et. al., 1997; Oz, 1997; Ozdemir & Kokten, 2020; Salisbury & Ross, 1992; Sedlmayr, 1966; Senf, 1961; Soya et. al., 1997; Voighlander & Jacob, 1987; Yilmaz, 2018;) working with fodder beet have given the following information on the subject: tuber yield is 5-20 tons/da, leaf yield is 1-4 tons/da, dry matter ratio is 8-28%, sugar content is 3-8%, and crude protein ratio is 5-10%.

The aim of this research is to determine the yield and yield factors of forage beet, which yields very high yields per unit area, in order to close the quality forage deficit in animals.

Materials and Methods

Climate Characteristics of the Research Area

The research was conducted in the Karapınar neighborhood of Adapazarı district (40° 47' 20" N, 30° 24' 21" E, and altitude 31 m), Sakarya province, located in the Eastern Marmara region. Climate data were taken from the Adapazarı Meteorology Station, which is approximately 14 km away from the research area. The periods when the research was conducted and the climate data for the long-term average (L.T.A.*) are given in Table 1.

In the first year when the experiment was conducted, the total rainfall (April-September) was 388 mm, the average temperature was 20.1 °C, and the relative humidity rate was 73.8%, while in the second year for the same period, these values were 248.5 mm, 20.3 °C, and 71.4%, respectively. The long-term average is 235.4 mm, 20.4 °C, and 68.7%, in the same order. In this case, the rainfall and relative humidity of both years in which the experiment was conducted are higher than the long-term average, while the average temperatures are very close to the long-term average.

Soil Properties of the Research Area

Soil samples taken from 0-20 and 20-40 cm depths of the research area were analyzed in the laboratory of Pamukova Vocational School and are given in Table 2.

The analysis results showed that the soil of the trial area had a clay loam structure at depths of 0-20 and 20-40 cm, showed a slightly acidic reaction in terms of pH value, did not cause any problems in terms of salinity, and was poor in terms of lime.

The soils of the research area, which are moderate in terms of nitrogen, are insufficient in terms of organic matter, useful phosphorus, and potassium (Brohi & Aydeniz, 1991). At depths of 20-40 cm, it is generally observed that nutritional elements gradually decrease.

Establishment and Evaluation of the Research

Establishment of the trial and parceling: The trial was established on April 10, 2021 in the first year and on April 10, 2022 in the second year. The plots were prepared and planted with 50 cm spacing between rows, 30 cm spacing between rows (Acikgoz, 2021), 16 plants per row of 5 m length, and 6.670 plants per decare.

Seed material: In the research, Rekord, Rota, Ursus, and Zentaur fodder beet varieties were used.

Cultural procedures: When the plants completed their germination and had 2-3 leaves, the misting process was carried out. In the trial; 15 kg/da triple super phosphate (TSP) and 30 kg/da ammonium nitrate (AN) fertilizer were applied. The entire TSP and 10 kg of AN were given together with the planting, and the other 20 kg of AN was given as 10 kg for both hoeing operations (Yilmaz, 2018). The experiment was hoed a total of 3 times and watered as necessary.

Harvest and storage: In both years, the harvest was made on October 15, when root growth stopped, the leaves dried and drooped, and the middle leaves began to turn yellow (Acikgoz, 2021). The vegetation period between planting and harvest is 185 days. Plant samples were taken from 20 plants in the middle, excluding 3 plants from each side of the 4 rows in the middle (2 rows in each plot); 10 of them were used for measurement and weighing, and the other 10 were stored in an unheated indoor area to determine storage losses. The storage period is 175 days, from harvest on October 15 to April 10, when the animals begin to access fresh green fodder in the spring. The tubers, which were weighed and stored on October 15, were weighed again on April 10, and the fresh weight losses of the tubers were determined by proportioning the differences to the first weighing figures.

Features examined: In the research; length (cm), diameter (cm), above-ground length ratio (%), yield (kg/da), dry matter content (%), dry matter yield (kg/da), crude protein ratio (%), sugar ratio (%) and weight loss in storage (%) were studied in the tuber. Additionally, in the leaf (6 features), length (cm), width (cm), yield (kg/da), dry matter content (%), dry matter yield (kg/da) and protein rate (%) were studied. Among the quality analyses, the crude protein ratio was made according to the Kjeldahl method and the sugar ratio was made according to the Betalyser method (Akyildiz, 1986; 2004).

Evaluation of the data: The experiment was set up with four replications according to the Randomized Blocks Trial Design, the statistical analysis of the obtained data was made in the TOTEMSTAT statistical program (Acikgoz et. al., 2004) and the Least Significant Difference (LSD, 5%) values are given below the tables.

Table 1. The climate dates of the trial area

Years	Total Precipitation (mm)	Average Temperature (°C)	Relative Humidity (%)
2021-22	388.0	20.1	73.8
2022-23	248.5	20.3	71.4
L.T.A.*	235.4	20.4	68.7

(*) Meteorological Station Adapazarı/Sakarya.

Table 2. Soil properties of of the trial area

Properties	Sample Depth (cm)	
	0-20	20-40
Structure	loamy	loamy
pH	6.61	6.91
Total salt (%)	0.024	0.023
CaCO ₃ (%)	5.61	7.58
Organic matter (%)	0.91	0.94
Nitrogen (kg ha ⁻¹)	0.58	0.61
P ₂ O ₅ (kg ha ⁻¹)	8.5	7.5
K ₂ O (kg ha ⁻¹)	195.0	225.0

Results

Tuber Properties

Tuber length (cm)

Tuber length values, which are one of the clear indicators of high yield, are given in Table 3. The longest tuber length was taken from the Ursus variety in both years and on average, and the shortest was from the Zentaur variety.

The number of 6.670 plants per square meter represents close to ideal plant density, and therefore the tubers were able to show their real performance in terms of length.

Tuber length data are close to the values of Oz (1997), Acar (2000) and Yılmaz (2018) and higher than the data of Abou-Deya (1991), Geren (1996) and Adiyaman (2003).

Tuber diameter (cm)

The data obtained from the measurements are presented in Table 3. According to the variety average, the widest diameter was measured in the Ursus variety at 14.6 cm, and the narrowest diameter was measured in the Zentaur variety at 11.8 cm.

In terms of years, the first year data (13.5 cm) is higher than the second year (12.6 cm). In terms of variety × year interactions, the Ursus variety gave the highest number with a diameter of 15.1 cm in the first year of the study.

Tuber diameter, which is a quantitative character and directly proportional to tuber length, is one of the most important components that make up tuber yield, and as plant density increases, tuber diameter decreases. The most suitable tuber diameter for machine harvesting is stated as 8 cm, and a tuber diameter that is too large is not desired.

The data obtained are similar to the data of Abou-Deya (1991), Acar (2000), Elmali (1998), and Yılmaz (2018), and are higher than the data of Adiyaman (2003), Geren (1996), and Oz (1997).

Tuber aboveground length ratio (%)

The data obtained are given in Table 3. The highest rate was determined in the Ursus variety with 64.4% and the lowest in the Zentaur variety with 52.6%. It was determined that the first year data was higher than the second year data in the values between years.

It is expected that the above-ground growth rate of the tuber will be similar to the tuber length values. It is known that fodder beet has high above-ground growth rates; therefore, it has been reported by Senf (1961) that their resistance to drought and cold is less Kampf et. al., (1985) and that large beets with external roots are more suitable for clayey soils.

The data obtained are close to the data of Adiyaman (2003), Oz (1997), and Yılmaz (2018), and higher than the data of Abou-Deya (1991), Anonymous (2002), and Geren (1996).

Tuber yield (kg/da)

Tuber yield values, which are the most important yield parameter, are given in Table 3. According to the variety averages, the highest yield was obtained from the Ursus variety with 19.309 kg/da, and the lowest yield was from the Zentaur variety with 12.845 kg/da. The first year data of the research is higher than the second year. In terms of variety × year interactions, it is seen that the Ursus variety gave the highest yield (19.958 kg/da) in the first year.

The weights of the tubers from which data were taken in the research were between 1.085 g (7.237 kg/da), and

4375 g (29.181 kg/da) and the average weight was determined as 2.730 g (18.209 kg/da). Tuber yield depends on the genetic capacity of the variety and the suitability of climate and soil conditions.

The data obtained are in line with the findings of Acikgoz (2021), Avcioglu & Sabanci (1993) and Soya et al., (1997), close to the findings of Cetin (1998), Oz (1997), and Yılmaz (2018), while it is higher than the data of Abou-Deya (1991), Adiyaman (2003), Anonymous (2002), Bartolomeus (1988), Cetin & Ozhan (1992), Elmali (1998), Geren (1996), Manga et al., (1997) and, Ozdemir & Kokten (2020).

Tuber dry matter content (%)

The results obtained from the weighing and proportioning of the dried samples are given in Table 3. The Ursus variety gave the highest dry matter content in both years and on average. In terms of years, first year data was higher than second year data.

Dry matter content; it is very important economically in animal feeding, silage making, and fresh storage (Akyildiz, 1986; Ergul, 1988; Geren, 1996; Soya et. al., 1997). Climate data and plant density during the year have a great impact on dry matter formation, as well as the genetic structure of the varieties. While tuber yield increases in rainy years and irrigated conditions, dry matter content decreases (Jankowak et. al., 1988).

The data obtained in the research (total precipitation and dry matter content in the first year: 988.7 mm, 13.8%, and in the second year, 781.4 mm and 14.7%) confirm this thesis. Some researchers (Akyildiz, 1986; Hofman et. al., 1970) report that there is a negative relationship between dry matter ratio in tubers and tuber yield.

The data obtained are close to the results of many studies (Abou-Deya, 1991; Anonymous, 2002; Bartolomeus, 1988; Ergul, 1988; Geren, 1996; Voighlander & Jacob, 1987; Yılmaz, 2018) and higher than the results of some studies (Adiyaman, 2003; Cetin, 1998).

Tuber dry matter yield (kg/da)

The data obtained by multiplying herbage yield and dry matter content are given in Table 3. The highest dry matter yield was obtained from the Ursus variety, both in terms of variety and variety × year interactions. Depending on the herbage yield, the first year data is higher than the second year data.

The research findings are consistent with Geren (1996) and Yılmaz (2018), lower than Bartholomeus (1988), and higher than Adiyaman (2003) and, Ozdemir & Kokten (2020).

Tuber crude protein ratio (%)

The determined crude protein ratios are given in Table 3. The highest values were taken from the Ursus variety in both years and on average (9.02, 9.58, and 9.30%). First year data (8.41%) is higher than second year data (8.79%).

The data obtained are consistent with the findings of Acar (2000) and Adiyaman (2003), and higher than the findings of Cetin (1998) and Ergul (1988) and, lower than Ozdemir & Kokten (2020).

Tuber sugar ratio (%)

The obtained figures are given in Table 3. The highest sugar content was obtained from the Ursus variety in both years and on average, and the lowest was from the Zentaur variety. Second year data (5.69%) was higher than first year data (5.38%).

Table 3. Data on tuber properties obtained in the study

Plant Varieties	Tuber Properties								
	Length (cm)			Diameter (cm)			Aboveground length (%)		
	1. Year	2. Year	Mean	1. Year	2. Year	Mean	1. Year	2. Year	Mean
Rekord	26.9	25.7	26.3	13.3	12.1	12.7	56.5	54.4	55.5
Rota	28.9	27.8	28.4	13.2	12.9	13.1	58.7	57.2	58.0
Ursus	29.7	28.4	29.1	15.1	14.1	14.6	66.2	62.5	64.4
Zentaur	24.9	24.3	24.6	12.4	11.1	11.8	52.9	52.3	52.6
Means	27.6	26.6	27.1	13.5	12.6	13.0	58.6	56.6	57.6
LSD 5%5	V:1.02	Y:0.6	V×Y:1.3	V:0.7	Y:0.5	V×Y:0.9	V:2.4	Y:1.7	V×Y:2.1
Plant Varieties	Yield (kg/da)			Dry matter content (%)			Dry matter yield (kg/da)		
	1. Year	2. Year	Mean	1. Year	2. Year	Mean	1. Year	2. Year	Mean
	Rekord	13.935	12.755	13.345	13.2	14.2	13.7	1.839	1.811
Rota	16.975	15.951	16.463	14.1	14.9	14.5	2.393	2.377	2.387
Ursus	19.958	18.661	19.309	15.4	16.4	15.9	3.074	3.060	3.070
Zentaur	13.565	12.125	12.845	12.5	13.2	12.9	1.696	1.601	1.657
Means	16.108	14.873	15.490	13.8	14.7	14.2	2.223	2.186	2.200
LSD 5%5	V:4.71	Y:2.61	V×Y:6.55	V:0.2	Y:0.3	V×Y:0.4	V:0.24	Y:0.13	V×Y:0.36
Plant Varieties	Crude protein ratio (%)			Sugar ratio (%)			Wet weight loss (%)		
	1. Year	2. Year	Mean	1. Year	2. Year	Mean	1. Year	2. Year	Mean
	Rekord	8.06	8.52	8.29	5.14	5.41	5.28	23.5	21.9
Rota	8.51	8.91	8.71	5.19	5.61	5.40	24.8	22.8	23.8
Ursus	9.02	9.58	9.30	6.11	6.58	6.35	26.9	25.1	26.0
Zentaur	8.04	8.16	8.10	5.06	5.15	5.11	22.6	21.1	21.9
Means	8.41	8.79	8.60	5.38	5.69	5.53	24.5	22.7	23.6
LSD 5%	V:0.51	Y:0.61	V×Y:0.78	V:0.28	Y:0.32	V×Y:0.41	V:0.5	Y:0.6	V×Y:1.2

(V: Varieties, Y:Year, V×Y: Varieties × Y)

Table 4. Data on leaf properties obtained in the study

Plant Varieties	Leaf Properties								
	Length (cm)			Width (cm)			Yield (kg/da)		
	1. Year	2. Year	Mean	1. Year	2. Year	Mean	1. Year	2. Year	Mean
Rekord	51.3	49.4	50.4	17.6	17.2	17.4	1.975	1.825	1.900
Rota	56.3	54.1	55.2	19.9	18.8	19.4	2.388	2.195	2.292
Ursus	63.5	58.4	61.0	21.6	20.1	20.9	2.685	2.485	2.585
Zentaur	50.2	48.1	49.2	17.2	16.7	17.0	1.898	1.725	1.812
Means	55.3	52.5	53.9	19.1	18.2	18.6	2.237	2.058	2.147
LSD % 5	V:0.38	Y:0.27	V×Y:0.53	V:0.27	Y:0.19	V×Y:0.32	V:265	Y:161	V×Y:287
Plant Varieties	Dry matter content (%)			Dry matter yield (kg/da)			Crude protein ratio (%)		
	1. Year	2. Year	Mean	1. Year	2. Year	Mean	1. Year	2. Year	Mean
	Rekord	12.2	13.1	12.7	241.0	239.1	240.0	21.9	21.2
Rota	13.2	14.2	13.7	315.2	311.7	313.5	22.8	22.1	22.5
Ursus	13.3	14.6	14.0	357.1	362.8	360.0	23.8	23.2	23.5
Zentaur	12.1	12.9	12.5	229.7	222.5	226.1	21.6	21.0	21.3
Means	12.7	13.7	13.2	284.0	281.9	283.0	22.5	21.9	22.2
LSD % 5	V:0.33	Y:0.24	V×Y:0.48	V:18.8	Y:764	V×Y:38.8	V:0.24	Y:0.13	V×Y:0.36

Sugar content in beets is directly proportional to the low rainfall, high temperature, and tuber dry matter content, the high altitude of the growing place and therefore the high day-night temperature difference. It is reported that the carbohydrates stored in the tuber during the day as a result of photosynthesis will not be lost when night temperatures drop to 6-7 °C and the sugar content is high (Acikgoz, 2021; Akyildiz, 1986; Ergul, 1988; Genckan, 1983; Salisbury & Ross, 1992). The fact that the altitude of the region where the research was conducted is low (31 m) and the temperature difference between day and night is less than in high altitude regions, caused the sugar rate to remain partially lower.

The results are lower than the data of Geren (1996) and Oz (1997), but close to those of Adiyaman (2003) and Yılmaz (2018).

Tuber weight loss in storage (%)

The obtained weight loss data are presented in Table 3. Among the varieties, the highest loss was determined in the Ursus variety with 26.0%, and the least loss was determined in the Zentaur variety with 21.9%. Loss rates in the first year were higher than in the second year. In terms of variety × year interactions, losses were high in parallel with the high tuber yield of the Ursus variety in both years.

One of the most important issues is that the entire product harvested for fodder beet cannot be consumed immediately, and therefore it must be preserved throughout the winter and until mid-spring. Storage can be done in open areas or in closed areas. No matter how the storage is done, a certain amount of yield loss is inevitable due to the tubers' ability to breathe, even if only slightly. In order to

reduce the loss, the open siled product should be covered with material that will not cause sweating, and in closed environments, the temperature should be low to minimize the respiration rate of the tubers. As temperature increases in storage, product loss also increases (Akyildiz, 1986; Ergul, 1988; Genckan, 1983; Soya et. al., 1997). An average loss of 23.6% (21.1-26.9) was determined for products stored in a closed warehouse without heating for 175 days.

The results are slightly less than the 27.3% loss of Adiyaman (2003) and Yilmaz (2018), who studied under Adapazarı conditions, and this shows that the storage conditions are appropriate.

Leaf Properties

Leaf length (cm)

Leaf length (including petiole) values taken from the leaves below the top leaves are given in Table 4.

In both years (63.5 and 58.4 cm), the longest average (61.0 cm) leaf length was taken from the Ursus variety, and the shortest tuber length was taken from the Zentaur variety.

While the leaf length data obtained in the study is compatible with the values reported by Albayrak & Yüksel (2009), it is higher than the values of Kokten & Ozdemir (2020).

Leaf width (cm)

Average data taken from the widest parts of the leaves below the uppermost leaves are given in Table 4. In both years and on average, the longest leaf length was taken from the Ursus variety, and the shortest tuber length was taken from the Zentaur variety.

While leaf width data obtained in the study is compatible with the values reported by Albayrak & Yüksel (2009), it is higher than the values of Kokten & Ozdemir (2020).

Herbage yield (kg/da)

Herbage yield values, one of the most important yield indicators, are presented in Table 4. According to the variety averages, the highest yield was obtained from the Ursus variety with 2.585 kg/da, and the lowest yield was from the Zentaur variety with 1.812 kg/da.

The first year data of the research is higher than the second year. In terms of variety \times year interactions, the Ursus variety gave the highest yield (2.685 kg/da) in the first year.

It is reported that high temperature and rainfall values encourage the plant to make more assimilation and provide more leaf yield (Acikgoz, 2021; Akyildiz, 1986; Ergul, 1988).

From planting to harvest in the 1st and 2nd years of the research; precipitation of 388.0-248.5 mm, average temperature of 20.1-20.3 °C, and relative humidity of 73.8-71.4% were calculated. The long-term average of the same period is 235.6 mm, 20.4 °C, and 68.7%, in the same order. In this situation; the rainfall and relative humidity of both years in which the experiment was conducted were higher than the long-term average, and the average temperatures were close but slightly lower. In this case, it is natural that the efficiency is high.

The research results are compatible with the results of some research (Abou-Deya, 1991; Cetin & Ozhan, 1992; Geren, 1996; Voighlander & Jacob, 1987; Yilmaz, 2018),

and higher than the results of some research (Adiyaman, 2003; Avcioglu & Sabanci, 1993; Cetin, 1998; Kokten & Ozdemir, 2020; Soya et. al., 1997).

Leaf dry matter content (%)

The results obtained by weighing and proportioning the dried samples are given in Table 4. The highest dry matter ratio was determined in the Ursus variety with 14.0%. In terms of years, the 2nd year data is higher than the 1st year data by 13.7%. In terms of variety \times year interactions, Ursus variety gave the highest rate with 14.6% in the second year. It is reported that the dry matter ratio of fodder beet leaves does not differ much according to the varieties and, is on average 12% (Sedlmayr, 1966).

The average 13.2% dry matter ratio obtained confirms Sedlmayr (1966) is similar to the findings of Adiyaman (2003), Geren (1996), and Yilmaz (2018), and is lower than the findings of Abou-Diya (1991) and Ergul (1988).

Leaf dry matter yield (kg/da)

The results are given in Table 4. The highest dry matter yield was obtained from the Ursus variety, both in terms of variety and variety \times year interactions. In terms of years, the first year data is higher than the second year data.

The research findings are consistent with Geren (1996) and Yilmaz (2018), lower than Bartholomaeus (1988), and higher than Adiyaman (2003), and Kokten & Ozdemir (2020).

Leaf crude protein ratio (%)

The data obtained according to the analysis results are presented in Table 4. The highest rate was obtained from the Ursus variety, with 23.5%. In terms of years, the first year data (22.5%) is higher than the second year data (21.9%). In terms of variety \times year interactions, Ursus variety gave the highest rate in both years.

The obtained rates are consistent with the data of Abou-Diya (1991), Cetin (1998), and Yilmaz (2018), and are higher than the results of Ergul (1988) and, Kokten & Ozdemir (2020).

Discussion and Conclusion

From the results obtained from the research, tuber yield, leaf yield, dry matter ratio, and yield, which are the most important yield characteristics for fodder beet, are the prominent features in evaluation both without and with storage.

It is reported that the average tuber yield of forage beet varieties is 5-20 tons/da, the leaf yield is 1-4 tons/da, and the dry matter rate is between 8-28% (Acikgoz, 2021; Akyildiz, 1986; Anonymous, 2002; Christiansen-Weniger et. al., 1979; Cetin, 1998; Genckan, 1983; Oz, 1997; Soya et. al., 1997; Voighlander & Jacob, 1987).

The average tuber yield of the four varieties used in this research is 15.490 kg/da (12.125 - 18.958 kg/da), the leaf herbage yield is 2.147 kg/da (1.725 - 2.685 kg/da) and the dry matter ratio values are 13.2% (12.1-14.6%).

As can be seen from the data obtained, the performances of the varieties tested were above average values than the results of many studies (Abou-Deya, 1991; Adiyaman, 2003; Anonymous, 2002; Avcioglu & Sabanci, 1993; Bartholomaeus, 1988; Cetin, 1998; Cetin & Ozhan, 1992; Elmali, 1998; Geren, 1996; Kokten & Ozdemir, 2020; Manga, et. al., 1997; Oz, 1997; Ozdemir & Kokten, 2020).

The reason for this is that the climatic conditions of the research area, especially rainfall and temperature, are suitable for fodder beet cultivation (Acikgoz, 2021; Akyildiz, 1986; Genckan, 1983; Sedlmayr, 1966; Senf, 1961). Because, according to the long-term averages of the research area; the amount of precipitation was determined to be 685.9 mm, the average temperature was 14.7 °C and the relative humidity was 74.1%. When all the data are examined, it is seen that the 1st year data is higher than the 2nd year data. This is because the rainfall amount in the 1st year (388 mm) was higher than the 2nd year (248.5 mm).

When the data obtained at the end of the research are evaluated as a whole, the average data of all varieties used in the research are within the reported and recommended limits for the fodder beet plant (Acikgoz, 2021; Akyildiz, 1986; Genckan, 1983; Sedlmayr, 1966; Senf, 1961). Although the data from all varieties were positive, as a result of the statistical analysis, the highest and most positive data were obtained from the Ursus variety. Fodder beet, which has a very high yield, is of great importance in filling the gap in quality forage for animals. For this reason, research on the subject; more clear and descriptive results should be achieved by using more varieties, different planting combinations, different fertilizer doses, and different soil types.

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