



Effects of Varying Nitrogen Doses on Forage Yield and Yield Components of Some Sweet Sorghum [*Sorghum bicolor* var. *saccharatum* (L.)] Genotypes Under Second Crop Conditions

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ABSTRACT

The study aimed to determine the effects of varying nitrogen doses on forage yield and yield components of different sweet sorghum genotypes under Mediterranean-type climate conditions as a second crop. The field experiments were conducted in Bursa Uludağ University, Faculty of Agriculture, in 2020-2021. The experimental design was a factorial randomized complete block with three replications. Three different sweet sorghum genotypes (Erdurmuş, Uzun, and M81-E) and four nitrogen doses (0, 75, 125, 175 kg ha⁻¹) were used in this research. Forage yield, dry matter yield, plant height, stem diameter, leaf number, leaf ratio, and stem ratio of sweet sorghum were investigated in the experiment. Among the three sweet sorghum genotypes studied, a varied range of average values was observed for plant height (288-262 cm), stem diameter (24.8-19.2 mm), leaf ratio (14.4%-11.5%), stem ratio (88.5%-85.6%), forage yield (56.2-28.6 t ha⁻¹), and dry matter yield (15.7-7.8 t ha⁻¹). According to the research results obtained in the second crop conditions, it can be recommended to grow the M81-E genotype using a nitrogen dose of 175 kg ha⁻¹.

1. Introduction

Sweet sorghum [*Sorghum bicolor* (L.)] closely resembles grain sorghum, except for its sugar-rich stalk. Sweet sorghum is going to crucial in supplying biofuel that can be mixed with gasoline in the increasing food and energy crisis scenario. Sweet sorghum is planted in several nations for ethanol production to satisfy the rising energy demand; it serves as a versatile cereal, including grain, forage, and sweet varieties. Sweet sorghum is primarily cultivated as a valuable source of syrup, animal feed, and ethanol. According to Nadir et al. (2009), it produces a higher ethanol yield compared to cassava. In addition, sweet sorghum stands out with its low

water demand and drought tolerance. It also features fast growth, early maturity, high overall energy potential, and adaptability to both subtropical and temperate climates. (Miri and Rana, 2012). The need for animal and poultry feed is growing quickly, both globally and domestically. Sorghum can serve as a significant source of feed for animals and poultry. Sweet sorghum is a quality alternative forage source in regions where climate and soil conditions are not suitable for silage corn (Pupo et al., 2022). On the other hand, it does not need much irrigation and fertilizer and can be grown in all climatic conditions because it is resistant to drought (Propheter et al., 2010). Recently, the importance of sorghum, a C4 plant, has been increasing due to global warming



(Gyawali et al., 2021; Visarada and Aruna, 2019). Compared to maize, sweet sorghum is comparatively well-suited to marginal growing circumstances such water logging, salinity, alkalinity, and water deficit stress; nonetheless, yields are usually maximum in deep, well-drained soils with good fertility (Regassa and Wortmann, 2014).

The most vital plant nutrient needed for crop production is nitrogen, which must be present in significant amounts (Wang et al., 2017). Even though N is crucial for sorghum's healthy growth and development, overfertilization is frequently detrimental because it lowers yield and quality (Addy et al., 2010). However, many researchers have stated that in order to increase the yield of the sorghum plant quickly, the fertilizer requirement must be met at the most appropriate level (Irshad et al., 2022). Nitrogen have positive effects on the yield of sweet sorghum plants (Almodares et al., 2008). Excess nitrogen is released into the environment in reactive forms like nitrate (NO₃⁻), ammonia (NH₃), and nitrogen oxides (NO_x and N₂O). The spread of these compounds across air, water bodies, and soil leads to numerous environmental threats, including eutrophication of surface and groundwater, soil acidification, deterioration of air quality, and intensification of global climate change, all of which pose risks to both human and ecological health. As a result, nitrogen pollution continues to be a major environmental issue and a significant concern for policymakers in both developed and developing nations (Giles, 2005, Tilman et al., 2001). Fertilizer also has a significant share in the cost of production; therefore, optimizing nitrogen

fertilizer as much as possible is imperative for profitability, productivity, and sustainability as well as in plant production. Optimal nitrogen rate can be different depending on ecological conditions, irrigation, and rainfall distribution (Mut et al., 2017). Ram and Singh (2001) reported that growth and yield responses of sorghum sudan grass to nitrogen rates were only up to 80 kg ha⁻¹. However, Ikanovic et al. (2010) reported that the optimal N rate for sorghum was 180 kg ha⁻¹.

Climate change has become a major factor influencing the agricultural sector. In the Mediterranean basin, where water resources are limited, the demand for drought-resistant plant species with efficient water use is growing steadily to ensure sustainable agriculture. In this context, cultivating sorghum varieties that combine high yield and quality with resilience to environmental stresses offers a promising alternative to maize.

This study aimed to investigate the effects of four nitrogen application levels on the yield performance of sweet sorghum genotypes grown as a second crop under Mediterranean-type climate conditions.

2. Material and Method

The two-year research was conducted at the Faculty of Agriculture, Bursa Uludag University, during 2020–2021. The experimental site was a temperate Mediterranean-type climate and located in the transitional regions of the country (Öztürk, 2010). In both experimental years, temperatures exceeded the long-term average, while precipitation levels remained below the norm (Table 1).

Table 1. Meteorological data of the Bursa province

Months	Temperature (°C)			Precipitation (mm)			Relative Humidity (%)		
	2020	2021	LT*	2020	2021	LT	2020	2021	LT
June	21.7	20.9	22.5	40.5	61.7	42.1	67.9	73.0	62.7
July	24.8	25.5	25.1	1.5	32.8	15.1	64.1	66.1	59.4
August	24.7	25.9	25.1	1.8	0.1	16.9	62.0	60.6	61.3
September	23.0	20.3	20.8	6.5	10.9	50.3	67.3	64.5	67.4
October	18.4	14.7	15.9	59.6	42.0	84.2	71.8	72.8	74.7
November	10.4	13.1	10.8	14.3	21.0	69.7	75.7	70.1	75.4
Total	-	-	-	137.2	168.5	373.3	-	-	-
Average	18.9	20.1	18.1	-	-	-	68.1	67.9	68.1

* LT: Long term (1990-2020)

The study used a factorial randomized complete block experimental design with three replications. Erdurmuş and Uzun (varieties), and the M81-E line

were used a plant material. Four different nitrogen rates (0, 75, 125, and 175 kg ha⁻¹) were used. The total experimental area encompassed 40 × 32.2 m.

Each plot consisted of five rows, each 5 meters long and spaced 0.7 meters apart, with 20 cm spacing between plants within each row. The soil of the experimental site was clayey in texture at the 0–20 cm depth, with a pH of 7.76. The sand, clay, and

silt contents were 25.95%, 58.60%, and 15.45%, respectively. The soil contained 4.30% CaCO₃ and 2.04% organic matter. Available phosphorus was 9.16, and potassium content was 100.67 kg da⁻¹ (Table 2).

Table 2. Soil characteristics of the experimental site based on analysis results.

Texture	Clay	pH	7.76
Depth (cm)	0-20	CaCO ₃ (%)	4.30
Sand (%)	25.95	Phosphorus	9.16
Clay (%)	58.60	Potassium (kg da ⁻¹)	100.67
Silt (%)	15.45	Organic matter	2.04

The sowing dates were 15 July 2020 and 13 July 2021 for the first and second years of the experiment, respectively. The plots were hand-seeded, and sprinkler irrigation was applied. Weed control in the experimental area was managed using 2,4-D. Nitrogen fertilizer was applied in two equal portions: half prior to seeding and the remaining half as urea (46% N) when the plants reached a height of 40–50 cm.

Plant height (cm), stem diameter (mm), leaf ratio (%), stem ratio (%), forage yield (t ha⁻¹), and dry matter yield (t ha⁻¹) were evaluated in this study. Prior to forage yield, ten plants were randomly selected from each plot to record morphological measurements (Yücel et al., 2018;

The combined two-year results showed that there were statistically significant (P<0.01) differences in forage yield and some yield components among sweet sorghum genotypes.

Demir, 2020). For forage yield determination, half of the central three rows in each plot were harvested at the soft dough to hard dough developmental stage. One representative plant from each plot was oven-dried at 70°C for 72 hours to assess dry matter yield (Yücel et al., 2018).

The collected data were analyzed using a factorial randomized complete block design, and a combined analysis was conducted to assess significant differences among genotypes. According to the F test results, significant differences among means were determined using the LSD (Least Significant Difference) test. Data analysis was performed in the JMP Pro 13 program.

3. Results and Discussion

Both sweet sorghum varieties and N fertilization treatments significantly affected all components. Nitrogen fertilization exhibited a significant influence on yield-related parameters (Table 3).

Table 3. Analysis of variance results of genotypes, nitrogen doses, and genotype x nitrogen doses interactions for forage yield and yield components.

Sources of Variation	Forage Yield (t ha ⁻¹)	Dry Matter Yield (t ha ⁻¹)	Plant Height (cm)	Leaf Ratio (%)	Stem Ratio (%)	Stem Diameter (mm)
Year (Y)	ns	ns	ns	ns	ns	ns
Genotypes (G)	**	**	**	**	**	**
Nitrogen Doses (ND)	**	**	**	*	**	**
Y x G	ns	ns	*	ns	ns	*
Y x ND	ns	ns	ns	*	ns	ns
G x ND	**	**	*	ns	ns	*
Y x G x ND	ns	ns	ns	ns	ns	ns

*, **: F-test significant at p ≤ 0.05 and p ≤ 0.01, respectively. ns: not significant.

Among the three sweet sorghum genotypes in the study, the highest plant height was found in the

M81-E genotype (288 cm) and followed by the Uzun (273 cm) and Erdurmuş (262 cm) varieties

(Table 4). Nitrogen fertilization consistently promoted taller plant growth by enhancing vegetative development and overall plant vigor (Table 5).

Table 4. Mean values for yield and yield components of genotypes.

Genotypes	Forage Yield (t ha ⁻¹)	Dry Matter Yield (t ha ⁻¹)	Plant Height (cm)	Leaf Ratio (%)	Stem Diameter (mm)	Stem Ratio (%)
Erdurmuş	28.6 b	7.8 b	262 c	11.5 c	19.2 c	88.5 a
Uzun	29.3 b	7.9 b	273 b	12.9 b	22.5 b	87.1 b
M81-E	56.2 a	15.7 a	288 a	14.4 a	24.8 a	85.6 c
LSD _{0.05}	3.0	0.7	6.5	1.0	1.3	1.0

Table 5. Mean values of nitrogen doses for forage yield and yield components.

Nitrogen Doses (kg ha ⁻¹)	Forage Yield (t ha ⁻¹)	Dry Matter Yield (t ha ⁻¹)	Plant Height (cm)	Leaf Ratio (%)	Stem Diameter (mm)	Stem Ratio (%)
0	27.6 d	7.2 d	259 c	9.5 c	16.7 c	90.5 a
75	37.0 c	10.0 c	264 c	12.8 b	22.2 b	87.2 b
125	40.4 b	11.3 b	279 b	14.3 a	23.6 b	85.7 c
175	46.0 a	13.5 a	296 a	15.0 a	26.2 a	85.0 c
LSD _{0.05}	3.4	0.8	7.5	1.2	1.5	1.2

Plant height is a morphological trait shaped by both genetic structure and environmental conditions. When genotypes are cultivated under identical environmental conditions and management practices, any observed variation in plant height can be attributed primarily to genetic differences among the genotypes (Tanrikulu et al., 2020). The plant heights of the studied genotypes are similar to those obtained in different studies around the world (Karataş, 2011; Afzal et al., 2012). Plant height, which is an effective morphological character in obtaining abundant and high-quality forage in forage crop cultivation, is affected by many factors (environmental conditions, fertilization, soil fertility, planting frequency, early or late variety) as well as genetic factors (Orou Ouennon Assouma and Çelen, 2022).

Many studies conducted with sweet sorghum genotypes (Avcıoğlu, 2018; Kaplan, 2021; Öktem et al., 2021b) have also emphasized that the differences between varieties/lines in terms of plant height are statistically significant. Kaplan (2021), who worked with the M81-E and USDA Taiwan genotypes, reported that these genotypes also had high plant height values in Diyarbakır second crop conditions. Öktem et al. (2021b) reported that the M81-E variety was the highest height with a plant height value of 476.30 cm in Harran Plain main crop conditions.

In studies conducted with sweet sorghum genotypes, plant height values, for example; It has been reported that it varies between 225.7-198.1 cm according to nitrogen doses in Bornova second crop conditions (Girgin, 2012), 340.8-252.3 cm in Şanlıurfa second crop conditions (Avcıoğlu, 2018), 368.3-268.7 cm in Çukurova second crop conditions in M81-E variety according to different water levels (Dündar et al., 2020), 373.7-326.1 cm in Diyarbakır second crop conditions (Kaplan, 2021), and 476.3-250.8 cm in Harran Plain main crop conditions (Öktem et al., 2021b). It can be said that the plant height values of the genotypes considered in the study are within the limits of this change range in the literature.

The highest plant height was obtained in the M-81-E genotype with 315 cm and 175 kg ha⁻¹ nitrogen dose interaction, while the shortest plant height was obtained in the Erdurmuş (241 cm) variety in the control plots where no nitrogen was applied (Table 6). In the study, plant heights increased from 0 kg ha⁻¹ nitrogen (control) application to 175 kg ha⁻¹ nitrogen application. It has been stated by many researchers that increasing N doses increase plant height by encouraging vegetative growth in plants (Kurai et al., 2015; Almodares and Hoseini, 2016; Sadighfard, 2016; Sawargaonkar et al., 2013). Acar and Akgün (2009) reported that plant height increased up to

180 kg N ha⁻¹ application in sweet sorghum in Konya conditions (226 cm), while Güler et al. (2003) reported that the highest plant height (209 cm) was reached in sorghum in Ankara conditions with 100 kg N ha⁻¹ application, and Gül et al. (2003) reported that increasing N doses did not have significant effects on plant height (154-151 cm) in Diyarbakır conditions.

The differences in average stem diameter were particularly notable with variations in genotypes. Stem diameter was 19.2 mm in Erdurmuş compared to 24.8 mm in M81-E genotype (Table 4). The highest fertilizer dose increased stem diameter by 56.9% compared to the control (Table 5). The highest stem diameters were obtained in the Uzun and M81-E genotypes with nitrogen doses of 175 kg ha⁻¹ and 125 kg ha⁻¹, respectively, while the lowest stem diameters were observed in Erdurmuş and Uzun genotypes in control plots where no nitrogen was applied (Table 6). The sweet sorghum genotypes used in this study produced stiff and

thick stemmed plants even in the lowest N fertilization regimes. Therefore, lodging was not a serious problem in the plots. Although stem thickness varies depending on some cultural practices, it is generally shaped as a result of the genetic characteristics of the plants (Kara et al., 2019; İptaş and Acar, 2003). In many studies conducted with sweet sorghum (Avcıoğlu, 2018; Adıyaman et al., 2020; Öktem et al., 2021b) and other sorghum species (Jeon et al., 2012; Çoban and Acar, 2018; Tekin, 2018), it has been reported that the difference between genotypes in terms of stem thickness is significant. In previous studies with sweet sorghum genotypes, stem diameter values varied between 19.15-28.83 mm (Avcıoğlu, 2018; Adıyaman et al., 2020; Dündar et al., 2020; Kaplan, 2021; Öktem et al., 2021b). In the study, it was observed that the stem thickness values measured in sweet sorghum genotypes were within this range in the literature.

Table 6. Mean values of genotype x nitrogen doses interactions for forage yield and yield components.

Genotypes	Nitrogen Doses							
	Forage Yield (t ha ⁻¹)				Dry Matter Yield (t ha ⁻¹)			
	1*	2	3	4	1	2	3	4
Erdurmuş	20.8 h	27.1fg	31.3def	34.8 cd	5.4 g	7.4 ef	8.9 de	9.7 d
Uzun	23.8gh	28.3efg	32.1 c/f	33.1cde	6.3 fg	7.5 ef	8.0 e	9.9 d
M81-E	38.1 c	55.6 b	61.1 b	70.1 a	9.9 d	15.0 c	17.1 b	21.0 a
LSD _{0.05}		6.01				1.48		
	Leaf Ratio				Stem Ratio			
Erdurmuş	9.0	11.0	12.4	13.4	91.0	89.0	87.6	86.6
Uzun	8.3	14.0	14.0	15.0	91.6	86.0	86.0	85.0
M81-E	11.0	13.3	16.3	16.7	89.0	86.6	83.6	83.3
LSD _{0.05}		-				-		
	Plant Height				Stem Diameter			
Erdurmuş	241 h	257 g	270 def	282 bcd	16.2 e	19.3 cd	19.6 cd	21.8 bc
Uzun	260 fg	263 efg	278 cd	291 b	15.1 e	23.6 b	24.0 b	27.3 a
M81-E	275 de	271 def	290 bc	315 a	19.0 d	23.6 b	27.2 a	29.6 a
LSD _{0.05}		13.0				2.6		

*1. 0 kg ha⁻¹, 2. 75 kg ha⁻¹, 3. 125 kg ha⁻¹, 4. 175 kg ha⁻¹

As a result of the research, the highest leaf ratio was determined in the M81-E genotype with 14.4%, followed by the Uzun variety with 12.9%, and Erdurmuş was the genotype with the lowest leaf ratio with 11.5% (Table 4). The variability of leaf ratio has also been reported in some other studies (Avcıoğlu, 2018; Öktem et al., 2021b). In addition, Öktem et al. (2021b) determined the leaf ratio as 13.1% in the M81-E variety, 11.3% in the Smith variety, 6.6% in the Tracy variety and 9.2%

in the Gülşeker variety. In studies conducted with sweet sorghum genotypes, it has been reported that the leaf ratio varies between 6.23-29.92% (Girgin, 2012; Avcıoğlu, 2018; Öktem et al., 2021b).

Among the nitrogen doses, the highest leaf ratio was obtained from 125 and 175 kg ha⁻¹ nitrogen doses, while the lowest leaf ratio was obtained from control plots where no nitrogen was applied. In our research, increasing nitrogen doses increased the leaf ratio. Leaf ratio is an important parameter for

quality and yield in forage crops grown with forage or silage. Because the highest protein content in sweet sorghum reaches up to 22% in leaves (Xie and Xu, 2019). A high leaf ratio is preferred to increase feed quality. As the leaf ratio increases, the digestibility and nutritional value of the feed also increase (Budak and Budak, 2014).

Statistically significant differences were determined between genotypes in terms of stem ratio at $p < 0.01$ level. While the M81-E genotype had the lowest stem ratio with 85.6%, the highest stem ratio was obtained from the Erdurmus genotype with 88.5% (Table 4). The stem ratio of sweet sorghum genotypes was determined as 56.2-66.5% in Bornova second crop conditions by Girgin (2012), 75.7-86.8% in Harran Plain second crop conditions by Avcioğlu (2018), and 74.7-91.5% in Harran Plain main crop conditions by Öktem et al. (2021b). It can be said that the data obtained in terms of stem ratio are compatible with the results in the literature.

Among the nitrogen doses, the highest stem ratio (90.5%) was obtained from the control plots where no nitrogen was applied, while the lowest stem ratio was obtained from the 125 (85.7%) and 175 (85.0%) kg ha^{-1} nitrogen doses. In our research, increasing nitrogen doses caused the stem ratio to decrease. Similarly, Kaplan et al. (2019) reported that increasing nitrogen doses initially led to an increase in stem ratio, followed by a decline, with the highest stem ratio observed at the intermediate nitrogen level (200 kg ha^{-1}). This trend partially supports our finding that the stem ratio tended to decrease under higher nitrogen doses. Similarly, Kaplan et al. (2019) reported that increasing nitrogen doses initially led to an increase in stem ratio, followed by a decline, with the highest stem ratio observed at the intermediate nitrogen level (200 kg ha^{-1}). This trend partially supports our finding that the stem ratio tended to decrease under higher nitrogen doses. (Table 5).

Variance analysis results and mean values of forage yield of sweet sorghum genotypes are presented in Table 3 and Table 4, respectively. Statistically significant differences were determined at the $p < 0.01$ level among the genotypes in terms of forage yield (Table 3). The highest forage yield was obtained from the sweet sorghum line M81-E (56.2 t ha^{-1}), while the

Variance analysis results and mean values of dry matter yield of sweet sorghum genotypes are presented in Table 3 and Table 4, respectively. Statistically significant differences were

difference between the forage yield of Erdurmus (29.3 t ha^{-1}) and Uzun (28.6 t ha^{-1}) genotypes was found to be statistically insignificant (Table 4). Researchers who reported that the differences in forage yield among sweet sorghum genotypes were significant reported that forage yield varied between Avcioğlu (2018) 9.3-18.4 t ha^{-1} , Adıyaman et al. (2020) 10.6-16.2 t ha^{-1} and Öktem et al. (2021b) 7.7-16.4 t ha^{-1} . In addition, Girgin (2012) reported that the average forage yield was 6.0-7.8 t ha^{-1} according to the nitrogenous fertilizer doses applied in the Keller variety, Dündar et al. (2020) reported that the forage yield was between 8.7-13.3 t ha^{-1} in the M81-E variety depending on the applied water levels, and Kaplan (2021) reported that the forage yield was between 8.8-11.6 t ha^{-1} in the M81E. The differences between the results obtained from the research and these data in the literature can be explained by genotype, climate, and soil differences. It is thought that yield differences are largely due to differences in climate and soil conditions. Since many researchers have reported that sweet sorghum varieties show great differences in terms of adaptation to climate and soil conditions (Clarke et al., 1997; Gnansounou et al., 2005; Laopaiboon et al., 2009).

Among the nitrogen doses, the highest forage yield was given at a nitrogen dose of 175 kg ha^{-1} , and forage yields also increased with increasing nitrogen doses (Table 5). The highest forage yield (70.1 t ha^{-1}) was given by the M81-E genotype in 175 kg ha^{-1} nitrogen dose. The lowest forage yield (20.8 t ha^{-1}) was given by the Erdurmus variety from the control plots where no nitrogen was applied (Table 6). Many studies have been conducted on nitrogen dose in different regions using different sweet sorghum varieties, and in these studies, the optimum nitrogen dose in terms of the highest green grass yield has shown significant differences. In order to obtain the highest forage yield, the nitrogen dose that should be used in the cultivation of the sweet sorghum was reported as 150 kg ha^{-1} in Bursa-Türkiye by Turgut et al. (2005), 200 kg ha^{-1} in Iran by Almodares et al. (2009), 135 kg ha^{-1} in Florida-USA by Erickson et al. (2012), 300 kg ha^{-1} in Isfahan/Iran by Almodares et al. (2013), 100 kg ha^{-1} in India by Bhutada et al. (2020), and 200 kg ha^{-1} in Adana-Türkiye by Nazli et al. (2020).

determined at the $p < 0.01$ level among the genotypes and nitrogen doses in terms of dry matter yield (Table 3). The highest dry matter yield was obtained from the sweet sorghum line M81-E

(15.72 t ha⁻¹), while the difference between the dry matter yield of Erdurmus (7.8 t ha⁻¹) and Uzun (7.9 t ha⁻¹) genotypes (Table 4). Among the nitrogen doses, the highest dry matter yield was given at a nitrogen dose of 175 kg ha⁻¹, and dry matter yield also increased with increasing nitrogen doses (Table 5). The highest dry matter yield (21.0 t ha⁻¹) was given by the M81-E genotype in 175 kg ha⁻¹ nitrogen dose. The lowest dry matter yield (5.4 t ha⁻¹) was given by the Erdurmuş variety from the control plots where no nitrogen was applied (Table 6). Many researchers (Ekefre et al., 2017; Gamawati Adinurani et al., 2018; Öktem et al., 2021a and Demir, 2020) have also reported that dry matter yields differ significantly among sweet sorghum varieties. It has been determined that different nitrogen doses significantly affect dry matter yield and the highest yield values are obtained from different nitrogen doses depending on the conditions. Turgut et al. (2005) reported that the highest dry matter yield was obtained from 150

kg N ha⁻¹ in Bursa-Türkiye, Tamang (2010) from 101 kg N ha⁻¹ in Texas/USA, Uchino et al. (2013) from 150 N ha⁻¹ in India, and Bhutada et al. (2020) from 100 N ha⁻¹ in India.

4. Conclusion

Under second crop conditions, all sweet sorghum genotypes exhibited increases in yield and yield components with rising nitrogen doses. Among the genotypes, M81-E outperformed the others in all measured parameters except stem ratio. Compared to the control treatment (0 kg ha⁻¹ N), the forage and dry matter yields of the M81-E genotype increased by approximately 83.9% (from 38.1 to 70.1 t ha⁻¹) and 112% (from 9.9 to 21.0 t ha⁻¹), respectively, at the nitrogen dose of 175 kg ha⁻¹. Therefore, cultivating the M81-E genotype with a nitrogen dose of 175 kg ha⁻¹ can be recommended for achieving high forage and dry matter yields under second crop conditions.

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