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THE NUTRITIONAL AND CHEMICAL CONTENT OF *Atriplex nitens* SEEDS GROWN UNDER RAINFALL AND NONFERTILIZE CONDITIONS

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ABSTRACT

Atriplex nitens **Schkuhr plant, which can grow under rainfall conditions without any fertilizer application and can produce high amounts of seeds, have been seen as an alternative feed resource in animal nutrition. However, no previous studies have been found revealing the feed quality content of the seeds with and without bracteole. For this purpose, a study was planned according to factorial experimental design in Randomized Complete Block Design with 3 replications. In this study carried out for 2 years (2021-2022) in Igdir arid conditions, crude protein (CP), dry matter (DM), acid detergent fibre (ADF), neutral detergent fibre (NDF), acid detergent lignin (ADL), raw ash (RA), dry matter digastiblity (DMD), metabolize enery (ME), dry matter intake (DMI) and relative feed values (RFV) of seeds with and without bracteole were determined and compared. Additionally, the effect of different row spacings (22.5, 45.0 and 67.5 cm) on the quality of the seeds with and without bracteole was also tested. As a result of the study, all feed quality characteristics examined were found to be important in terms of seed types and it was determined that the desired feed quality values (the highest DMD, DMI, CP, ME, RFV and the lowest ADF, DM, NDF, RA and ADL) were more suitable in seed without bracteole. Only CP, NDF and ADL were found to be important in terms of inter-row spacing, and these values increased with increasing inter-row spacing. In addition to the plant having a high seed yield per unit area, considering the seed feed quality values examined in this study, it showed that the seeds with and without bracteole can be used as a good alternative roughage and concentrated feed source, respectively.**

Keywords: Alternative feed, Feed value, Seeds with and without bracteole, Plant density

INTRODUCTION

For a profitable livestock farming, feed must be provided cheaply. Because in animal production, although it varies depending on animal breeds, approximately 70% of production costs go to feed expenses (Harmansah, 2018). In this sense, meadow-pastures and forage crops cultivation areas within field agriculture are among the primary sources that provide cheap and quality feed material to animals. However, changes in climate due to increasing global warming in the last century have increased the pressure on natural resources (such as soil, water, pasture and forest), causing an increase in marginal areas, a decrease in species diversity and density, a weakening of vegetation covers, and a decrease in the amount and quality of grass produced (Temel and Sahin, 2011; Yavuz et al., 2020). As a result, the desired animal product performances cannot be obtained from farm animals that are exposed to inadequate and unbalanced nutrition, or animal husbandry becomes unprofitable due to additional feed costs. For this reason, scientists and producers have in search of alternative feed sources to meet the roughage deficit. In this sense, xerophyte and halophyte species that can grow in areas that are out of production due to salinity and drought have been seen as an important advantage.

The genus *Atriplex* contains more than 260 species, most of which are salt-tolerant, adapted to the arid and semi-arid regions of the Earth, especially Europe, Asia, Africa, Australia and North America (Kadereit et al., 2010; Tan and Temel, 2012). One of these species is *Atriplex nitens*, which can easily grow in extreme climate and soil conditions. It can produce medium quality (11.05% CP, 57.9% NDF, 60.5% DMD and 98.9 RFV) and high amounts of roughage (138.1 t ha^{-1} of fresh hay and 37.5 t ha^{-1} of hay) per unit area without any fertilizer application (Keskin and Temel, 2022; Temel and Keskin, 2022a; Temel et al., 2022a; Temel et al., 2022b). These results showed that the hay material produced by *Atriplex nitens* can be used as an alternative roughage resource in animal nutrition. It has also been reported that its seeds with high secondary compounds are widely used in the health and food sectors (Acar et al., 2017; Rinchen et al., 2017; Kadioglu et al., 2022).

Atriplex nitens Schkuhr, an annual herbaceous plant, is a heterocarpic species which produces three types of fruits that differ in ecological and morphology properties

(Mandák and Pyšek, 2005). The plant grown without any fertilizer application can produce high amounts of seed (18.4 t ha^{-1}) and stem (39.3 t ha^{-1}) material in dry conditions (Keskin et al., 2023). These values can reach 30.6 t seed yield and 49.7 t stem yield per hectares under irrigated conditions (Temel and Keskin, 2022b). In addition, 8.9-13.2 t seed and 21.7-39.7 t stem yields per hectares were obtained from *Atriplex nitens* grown in 22.5, 45.0 and 67.5 cm inter-row spacings in dry conditions without applying fertilizer, depending on the inter-row spacing (Temel et al., 2024). Considering these high seed yields obtained from extreme growing conditions, *Atriplex nitens* has been seen as a great advantage both in terms of bringing the abandoned areas into production due to drought and salinity and in providing a feed source for animals. However, no study has been found that reveals the feed quality properties of *Atriplex nitens* seeds for use as a feed resource in animal nutrition.

The aim of the study was to determine some nutritional and chemical composition contents of seeds with and without bracteole obtained from Atriplex nitens grown in different inter-row spacings under nonfertilize and rainfall conditions.

MATERIALS AND METHODS

The research was carried out in two stages: field and laboratory conditions. Field studies were established for two years (2021 and 2022) in Igdir Province (39° 55′43″ N, 44° 05′ 41″ E), which has the driest climate of Turkey. According to the long-term average (1978-2020) of the study area, the total amount of precipitation was 176.2 mm, the relative humidity was 47.7% and the average temperature was 19.0 ºC (Anonymous, 2023). In 2021 and 2022, when the research was conducted, average temperature, the total rainfall and relative humidity values of the region were measured as 21.4-20.2 ºC, 159.8-137.5 mm and 44.5-45.6%, respectively. These results showed that the amount of precipitation in 2022 during the development period of the plants was lower than the average of 2021 and long-term. Soil samples were taken from the study area (0-30 cm depth) before sowing and analyzed (Kacar, 2012). The results are presented in Table 1.

Table 1. Some chemical and physical properties of soils of research area.

	Saturation (%)	**pH**	**Total salt (%)**	**$CaCO_3$ (%)**	**Org. matter (%)**	**P_2O_5 (t ha^{-1})**	**K_2O (t ha^{-1})**
2021	57.00	7.65	0.17	3.63	0.75	0.46	0.36
2022	68.00	7.89	0.20	4.30	0.51	0.36	0.32
Class	Clay loam	Slightly alkaline	Slightly saline	Calcareous	Very little	Little	Sufficient

The study was established according to factorial experimental design in Randomized Complete Block Design with three replications under rainfall conditions. In the research, different inter-row spacings (22.5 cm, 45.0 cm and 67.5 cm) were evaluated as factors. There were 12 rows in the plots with 22.5 cm inter-row spacing, 6 rows in 45.0 cm inter-rows and 4 rows in 67.5 cm inter-rows. Accordingly, the area of each plot was planned as 8.1 m^2 (2.70 x 3.0 m). The seeds were sown by hand in the lines made with a marker at a distance of 10 cm in rows and a depth of 4 - 5 cm. Since climate and soil conditions differ from year to year, sowings were carried out on 21.03.2021 in the first year and on 27.03.2022 in the second year. In the current study, no irrigation, fertilizer, insecticide or herbicide was applied to the plants. Only the weeds that appeared between the plots and blocks were controlled by hand pulling and hoeing. Seed harvests were made from 10 randomly selected plants within the plot, when 75% of the fruits on the plant turned yellow (Temel and Keskin, 2022b).

In laboratory studies, threshing processes and feed quality analyzes of the seeds were carried out. Following harvest, the plants brought to the laboratory were kept on the benches for 4-5 days to ensure that they dried thoroughly. After drying, the plants in all treatments were threshed and the fruits were separated from the stems. In this way, seeds with bracteole were obtained (Figure 1a). To obtain seeds without bracteole, seeds with bracteole were removed by rubbing with the hand (Figure 1b).

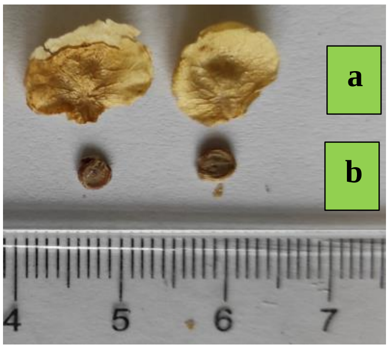

Figure 1. Seeds with bracteole (a) and seeds without bracteole (b)

Then, the seeds with and without bracteole were ground separately in a mill to pass through a 1-mm screen and were made ready for chemical analysis. To determine the dry matter, 3 g of ground sample was dried in a drying oven set at 105 ºC until it attained a constant weight (AOAC, 2020). Total nitrogen amounts were determined according to the Micro Kjeldahl method, and then this value was multiplied by the coefficient of 6.25 to calculate the percent crude protein ratios. For raw ash, 1 gram of ground sample was placed in porcelain crucibles and burned for 8 hours in a muffle furnace set at 550 ºC. Following the burning, the crucibles taken out of the furnace were kept in the desiccator for 2 hours and then the raw ash ratios were determined by weighing (AOAC, 2020). Neutral detergent fibre (NDF%), acid detergent fibre (ADF%) and acid detergent lignin (ADL%) contents were determined on the

ANKOM fiber analyzer device using the method developed by Van Soest et al. (1991). Dry matter digestibility (%) and relative feed value (Boman, 2003), dry matter intake (%) and digestible energy (Mcal kg^{-1}) (Sheaffer *et al*., 1995) and metabolize energy (Mcal kg^{-1}) content (Khalil *et al*., 1986) of the samples were determined using the following equations developed by researchers.

DMD = 88.9 -(0.779 x ADF) (1)

DE = 0.27 + 0.0428 x DMD (2)

ME = 0.821 x DE (3)

DMI = 120 /NDF (4)

RFV = (DMD x DMI) / 1.29) (5)

In the JMP (5.0.1) statistical package program (SAS Institute, 2003, Cary, NC, USA), the results obtained from the current study were subjected to analysis of variance according to factorial experimental design in Randomized Complete Block Design repeatedly over the years. Comparison of significant means was made according to the LSD $_{(0.05)}$ test.

RESULTS AND DISCUSSION

In this article, some feed quality characteristics of *Atriplex nitens* seeds grown in different inter-row spacings under nonfertilize and rainfall conditions were examined. Seed yield characteristics, which are a part of the current study, were determined by Temel et al. (2024) and it was reported that high seed and stem yields were obtained per unit area (Table 2). These results have shown that the *Atriplex nitens*, which can grow in extreme conditions, can be an important alternative feed resource.

Table 2. Mean seed and stem yields obtained from different inter-row spacings in *Atriplex nitens**.

Years	Seed yield (t ha^{-1})			Mean of years	Stem yield (t ha^{-1})			Mean of years
	22.5	45.0	67.5		22.5	45.0	67.5	
2021	13.72	11.49	9.18	11.47	34.76	24.97	19.36	26.36
2022	12.57	10.09	8.69	10.45	44.64	28.45	21.13	32.41
Mean of inter-rows	13.15	10.79	8.93	10.96	39.70	26.71	21.74	29.38

* Temel et al. (2024).

Variance analysis results, F values and significiances regarding the feed quality characteristics of *Atriplex nitens* seeds grown in different inter-row spacings are given in Table 3. When Table 3 was examined, it was found that there was a significant difference between the years in terms of CP, NDF, DMI and EFV, between the row spacings in terms of CP, NDF and ADL and between seed types in terms of all quality values examined. And also it was found that year x seed type interaction and inter-row spacing x seed type interactions were significant in terms of NDF and RA, respectively.

Table 3. The mean squares values of the examined quality parameters according to factorial experimental design in Randomized Complete Block Design.

SV	df	DMR	CP	RA	NDF	ADF	ADL	DMD	DMI	ME	RFV
Y	1	4.43 n.s.	21.95**	0.11 n.s.	81.78**	4.07 n.s.	1.97 n.s.	2.48 n.s.	1.75*	0.00 n.s.	7178*
R	2	19.4 n.s.	17.62**	0.91 n.s.	9.80*	4.01 n.s.	2.06*	2.42 n.s.	0.76 n.s.	0.00 n.s.	4031 n.s.
YxR	2	2.21 n.s.	0.73 n.s.	0.09 n.s.	0.72 n.s.	0.05 n.s.	0.14 n.s.	0.03 n.s.	0.12 n.s.	0.00 n.s.	487 n.s.
T	1	321**	926**	380**	3961**	875**	62**	531**	420**	0.66**	18572**
YxT	1	0.18 n.s.	0.89 n.s.	0.45 n.s.	67.5 n.s.	0.65 n.s.	0.64 n.s.	0.40 n.s.	0.53 n.s.	0.00 n.s.	1525 n.s.
RxT	2	8.58 n.s.	0.01 n.s.	2.30**	3.21 n.s.	0.58 n.s.	0.03 n.s.	0.35 n.s.	0.11 n.s.	0.00 n.s.	874 n.s.
YxRxT	2	2.34 n.s.	0.06 n.s.	0.06 n.s.	0.46 n.s.	0.14 n.s.	0.01 n.s.	0.08 n.s.	0.13 n.s.	0.00 n.s.	588 n.s.

*P< 0.05, **P< 0.01, n.s.; non-significant, SV: sources of variation, df: degree of freedom, Y: year, R: Inter-row T: seed type DMR: dry matter rate, CP: crude protein, RA: raw ash, NDF: neutral detergent fibre, ADF: acid detergent fibre, ADL: acid detergent lignin, DMD: dry matter digestibility, DMI: dry matter intake, ME: metabolizable energy.

Dry matter and crude protein rates

When Table 4 is examined, the dry matter ratio of seeds with bracteole was found to be higher than seeds without bracteole. The fact that the amount of fruiting bracteole with low moisture content is high in the seeds with bracteole may have caused this. As a matter of fact, in a study conducted on barley, it was stated that hulled grains had a higher dry matter ratio than hulless ones (Salem et al., 2023).

In the study, it was determined that the crude protein content of seeds without bracteole (26.98%) was higher than that of seeds with bracteole (16.84%) (Table 4). This may be due to the presence of fruiting bracteoles rich in cell wall substances (cellulose, hemicellulose, lignin) in seeds with bracteole. Because fruiting bracteoles contain less intracellular substances (sugar, protein and fat) than endosperm (nutrient tissue). As a matter of fact, in studies conducted on different species, it was stated that naked grains had higher crude protein content than hulled seeds (Biel et al., 2009; Abdel-Haleem and Awad, 2015).

Additionally, Wright et al. (2002) found that the protein content of naked *Atriplex hortensis* seeds varied between 25.7-28.3% and that these values were compatible with current research results. On the other hand, crude protein contents of some concentrated feeds (corn grain: 8.47%, barley grain: 12.23%, wheat grain: 13.43%) widely used in animal nutrition were revealed by Kurt et al. (2022) and the values obtained in the current study were found to be higher. In addition, when the crude protein contents determined in the current study were compared according to roughage quality standards, it was seen that seeds with bracteole were in the high quality group and seeds without bracteole in the best quality group (Rivera and Parish, 2010).

Table 4. Means of dry matter and crude protein ratios of seeds with and without bracteole obtained from different inter-row spacings.

Years	Inter-rows (cm)	DM rate (%)		Mean of years	CP rate (%)		Mean of years
		SB	SWB		SB	SWB	
2021	22.5	93.31	88.93	89.86	16.26	26.23	22.69 a
	45.0	92.91	87.93		17.87	27.48	
	67.5	92.52	83.56		19.19	29.10	
2022	22.5	92.58	87.89	89.16	14.92	25.27	21.13 b
	45.0	92.01	85.92		15.98	26.51	
	67.5	91.62	84.92		16.79	27.28	
Mean of seed types		92.49 a	86.52 b		16.84 b	26.98 a	
Mean of inter-rows		22.5 cm	45.0 cm	67.5 cm	22.5 cm	45.0 cm	67.5 cm
		90.68	89.69	88.16	20.67 c	21.96 b	23.09 a
$LSD_{(0,05)}$		T: 1.87			Y: 0.61, R: 0.74, T: 0.61		

Means with different letters are statistically significant. Y: year, R: Inter-row T: seed type, SB: seed with bracteole, SWB: seed without bracteole, DM: dry matter rate, CP: crude protein.

Crude protein content of the seeds varied between 20.67-23.09% according to row spacing, and it was observed that the protein content increased with increasing row spacing (Table 4). In addition, the crude protein rate of the seeds was found to be higher in 2021 compared to 2022. This may be due to the fact that the plants grown both in wide row spacing and in 2021 (in the months corresponding to the period when the seeds mature) benefit more from the environmental conditions (rainfall, light, nutrients, etc.) and produce the plumper and larger seeds. Regarding the subject, in a study conducted on *Atriplex nitens*, it was reported that plants grown in a year (2021) when the climatic conditions were suitable and in a wide row spacing produced seeds with a higher 1000 grain weight (Temel and Keskin, 2022b; Temel et al., 2024). Because larger seeds can generally have more nutritive tissue or intracellular non-structural carbohydrates (protein, sugar, starch and fat). As a matter of fact, in studies conducted on different plants, it has been reported that crude protein rates increase as 1000 grain weight increases depending on species and varieties (Tan and Temel, 2019; Hicks et al., 2022).

Raw ash and neutral detergent fibre rates

Considering Table 5, it was determined that RA (11.27%) and NDF (32.28%) contents of seeds with bracteole were higher than those of bracteole-peeled seeds (RA: 4.77% and NDF: 11.40%). This may be due to the fact that seeds with bracteole contain a high amount of fruiting bracteole rich in cell wall substances. Because the cell walls that form the fruiting bracteoles are thicker and richer in structural carbohydrates (cellulose, hemicellulose) and ash content (Zhao et al., 2015; Han and Hendek Ertop, 2022). Regarding the subject, Wright et al. (2002) determined the ash content of naked *Atriplex hortensis* seeds as 3.5%. Additionally, in studies conducted on different species, it has been stated that hulled grains have higher cellulose, hemicellulose, lignin and ash contents than hulless grains (Choi et al., 2011; Saleem et al., 2023).

Table 5. Means of raw ash and neutral detergent fibre contents of seeds with and without bracteole obtained from different inter-row spacings.

Years	Interrows (cm)	RA rate (%)		Mean of years	NDF rate (%)		Mean of years
		SB	SWB		SB	SWB	
2021	22.5	11.33	4.28	7.97	33.62	10.94	23.40 a
	45.0	11.16	4.62		35.58	11.54	
	67.5	10.82	5.59		36.56	12.13	
2022	22.5	11.50	3.92	8.08	28.42	11.11	20.38 b
	45.0	11.44	4.77		28.94	11.21	
	67.5	11.38	5.46		31.15	11.47	
Mean of seed types		11.27 a	4.77 b		32.28 a	11.40 b	
Mean of inter-rows		22.5 cm	45.0 cm	67.5 cm	22.5 cm	45.0 cm	67.5 cm
		7.76	8.00	8.31	21.02 b	21.82 ab	22.83 a
$LSD_{(0,05)}$		T: 0.43, R x T: 0.74			Y: 1.04, R: 1.27, T: 1.04, Y x T: 1.47		

Means with different letters are statistically significant. Y: year, R: Inter-row T: seed type, SB: seed with bracteole, SWB: seed without bracteole, RA: raw ash, NDF: neutral detergent fibre.

The values of NDF content obtained in this study showed that both seeds with and without bracteole were included in the best quality class according to roughage quality standards (Rivera and Parish, 2010). In another study, the NDF contents of wheat bran, corn, barley and wheat grains, which are preferred as concentrated feed sources, were determined as 47.15%, 24.56%, 43.64% and 29.79%, respectively (Kurt et al., 2022). According to these results, it was observed that the NDF (except corn and wheat grain) contents of seeds with and without bracteole were lower. In addition, it was determined that the raw ash contents obtained from both seed types were higher than the raw ash content of wheat bran (2.93%), corn (1.57%), barley (3.04%) and wheat (2.52%) grains determined by Kurt et al. (2022).

In the study, it was determined that the NDF content of the seeds increased with increasing inter-row spacing and also that the seeds had a higher NDF content in 2021 (Table 5). This may be due to the fact that plants grown in wide row spacing and in 2021, when the environmental conditions were suitable, produced larger seeds and larger seeds had a higher amount of fruiting bracteole. As a matter of fact, Mandák and Pyšek (2005) reported that *Atriplex sagitata* sown at low density had larger fruits and larger fruits had more fruiting bracteole. In addition, in a study conducted with different oat varieties, it was revealed that the husk ratio increased in seeds with a weight of 1000 grains (Sobayoglu and Topal, 2019). Therefore, it is thought that a high husk or fruiting bracteole ratio increases the NDF content of the seeds.

Although the raw ash content of seeds with bracteole did not change according to inter-row spacing, it was observed that the raw ash content of bracteole-peeled seeds increased with increasing inter-row spacing (Figure 2a). This caused the row spacing x seed type interaction to be significant. When evaluated in terms of year x seed type interaction, the NDF content of seeds without bracteole did not change according to years while the NDF content of seeds with bracteole increased in 2021 (Figure 2b). This may have been caused by the fact that seeds with bracteole had a higher fruiting bracteole ratio due to suitable climatic conditions in 2021 (Temel et al., 2024). As a matter of fact, seeds with a high hull ratio may contain higher amounts of extracellular substances such as cellulose, hemicellulose and lignin (Saleem et al., 2023).

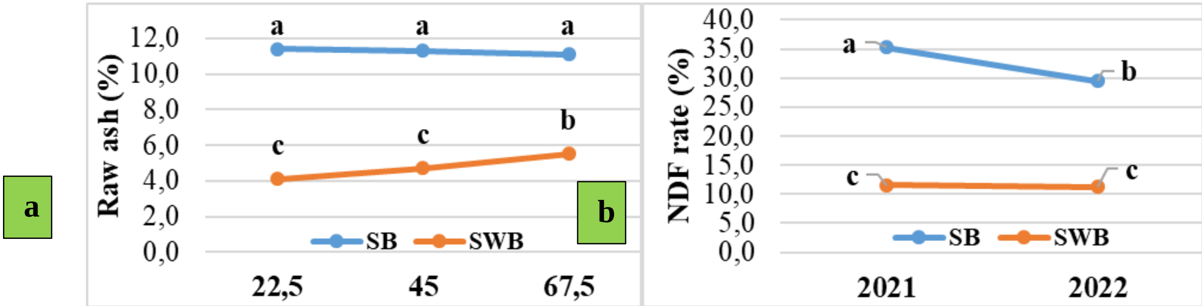

Figure 2. Effects of inter-row x seed type interaction on raw ash (a) and year x seed type (b) on NDF rate. Plots followed by the different letters are statistically significant, SB: seed with bracteole, SWB: seed without bracteole, NDF: neutral detergent fibre.

Acid detergent fibre and acid detergent lignin rates

While ruminant animals can partially digest the ADF, one of the cell wall components, Due to their digestive systems, they cannot digest lignin (ADL). Therefore, it is not desired that ADF (more than 45%) and ADL (more than 20%) contents are high since they negatively affect the digestibility of DM and NDF of the feed. In addition, the ADF and ADL rates of seeds without bracteole were found to be lower than those of seeds with bracteole (Table 6). Accordingly, the ADF content of seeds with and without bracteole was determined as 19.22% and 9.36%, and the ADL content was determined as 5.97% and 3.36%, respectively. These results showed that both seed types were of the best quality according to roughage quality standards (Rivera and Parish, 2010). This difference between seed types might be due to the absence of fruiting bracteoles in seeds with bracteole. Since the fruiting bracteoles contain a higher amount of cell wall components (Hoije et al., 2005; Zhao et al., 2015).

In this study, ADL content increased as inter-row spacing increased. The highest ADL content was determined in the wide row spacing (67.5 cm) (Table 6). This can be caused by the fact that plants growing in wide inter-row spacing produce larger seeds. Because larger seeds can generally have a higher husk rate (Mandák and Pyšek, 2005; Sobayoglu and Topal, 2019). As a matter of fact, in many species, it was determined that the part of the seed containing the most lignin was the husk (Choi et al., 2011; Abdel-Haleem and Awad, 2015).

Table 6. Means of acid detergent fibre and acid detergent lignin rate of seeds with and without bracteole obtained from different inter-row spacings.

Years	Inter-rows (cm)	ADF rate (%)		Mean of years	ADL rate (%)		Mean of years
		SB	SWB		SB	SWB	
2021	22.5	19.27	8.93	14.63	5.82	2.95	4.90
	45.0	19.84	9.20		6.41	3.36	
	67.5	19.96	10.57		6.78	4.06	
2022	22.5	18.24	8.49	13.96	5.27	2.91	4.43
	45.0	18.85	9.14		5.69	3.30	
	67.5	19.17	9.85		5.86	3.56	
Mean of seed types		19.22 a	9.36 b		5.97 a	3.36 b	
Mean of inter-rows		22.5 cm	45.0 cm	67.5 cm	22.5 cm	45.0 cm	67.5 cm
		13.73	14.26	14.89	4.24 b	4.69 ab	5.07 a
$LSD_{(0,05)}$		T: 0.85			R: 0.61, T: 0.49		

Means with different letters are statistically significant. Y: year, R: Inter-row T: seed type, SB: seed with bracteole, SWB: seed without bracteole, ADF; acid detergent fibre, ADL: acid detergent lignin.

Dry matter digestibility and dry matter intake

Dry matter intake (DMI) indicates the amount of dry matter consumed by animals, while dry matter digestibility (DMD) refers to the part of dry matter digested by animals. Therefore it is desired that the values are high in a feed. Considering the DMD and DMI obtained from the research (Table 7), it was seen that *Atriplex nitens* seeds were in the best quality group according to quality standards (Rivera and Parish, 2010). In the current study, DMD and DMI were found to be higher in bracteole-peeled seeds than seeds with bracteole. Additionally, the highest DMI was determined in 2021 (Table 7). This is due to the fact that ADF and NDF are lower in seeds without bracteole and in 2022. Because DMD and DMI are calculated by using ADF and NDF values, respectively (Boman, 2003).

Table 7. Means of dry matter digestibility and dry matter intake of seeds with and without bracteole obtained from different inter-row spacings.

Years	Inter-rows (cm)	DMD (%)		Mean of years	DMI (%)		Mean of years
		SB	SWB		SB	SWB	
2021	22.5	73.89	81.95	77.51	3.57	11.05	6.94 b
	45.0	73.44	81.73		3.37	10.44	
	67.5	73.35	80.67		3.28	9.95	
2022	22.5	74.69	82.29	78.03	4.23	10.81	7.38 a
	45.0	74.22	81.78		4.15	10.71	
	67.5	73.97	81.23		3.90	10.51	
Mean of seed types		73.93 b	81.61 a		3.75 b	10.58 a	
Mean of inter-rows		22.5 cm	45.0 cm	67.5 cm	22.5 cm	45.0 cm	67.5 cm
		78.20	77.79	77.31	7.41	7.17	6.91
$LSD_{(0,05)}$		T: 0.67			Y: 0.43, T: 0.43		

Means with different letters are statistically significant. Y: year, R: Inter-row T: seed type, SB: seed with bracteole, SWB: seed without bracteole, DMD: dry matter digestibility, DMI: dry matter intake.

Metabolizable energy and relative feed value

When Table 8 was examined, it was found that the metabolizable energy (ME) and relative feed value (RFV) of seeds without bracteole were higher than those of seeds with bracteole. This was due to the fact that bracteole-peeled seeds had low ADF ratio and high DMD. As a matter of fact, ME and RFV are calculated by using the ADF and NDF values (Khalil et al., 1986). According to this calculation, ME and RFV of feeds with high NDF and ADF content are low, and vice versa, they are high (Kutlu, 2008). According to NRC (2007), the daily amounts of ME required for survival of ruminants with a live weight of 50 kg is 1.91 Mcal. Accordingly, it has been observed that seeds with and without bracteole has ME content that can provide the daily live weight gain in addition to the survival requirement of ruminants. It was also observed that RFV obtained from the study was much higher than the values that should be found in a quality forage. As a matter of fact that according to roughage quality standards, it was reported fact that feeds with a RFV of over 151 were in the best quality class (Rivera and Parish, 2010).

Table 8. Means of metabolizable energy content and relative feed value of seeds with and without bracteole obtained from different inter-row spacings.

Years	Inter-rows (cm)	ME (Mcal kg^{-1}) SB	SWB	Mean of years	Relative feed value SB	SWB	Mean of years
2021	22.5	2.82	3.10	2.95	204.52	701.81	428.05 b
	45.0	2.80	3.09		192.07	661.35	
	67.5	2.80	3.06		186.62	621.91	
2022	22.5	2.84	3.11	2.96	244.74	689.58	456.29 a
	45.0	2.83	3.10		238.77	679.07	
	67.5	2.82	3.07		223.48	662.09	
Mean of seed types		2.82 b	3.09 a		215.03 b	669.30 a	
Mean of inter-rows		22.5 cm	45.0 cm	67.5 cm	22.5 cm	45.0 cm	67.5 cm
		2.97	2.96	2.94	460.16	442.82	423.52
$LSD_{(0,05)}$		T: 0.02			Y: 26.29, T: 26.29		

Means with different letters are statistically significant. Y: year, R: Inter-row T: seed type, SB: seed with bracteole, SWB: seed without bracteole, ME: metabolizable energy.

CONCLUSION

In this study, it was founded that bracteole-peeled seeds had higher desired feed quality values than seeds with bracteole in terms of the feed quality characteristics. The results showed that the nutritional contents of seeds without bracteole were higher than the nutritional values of some cereal grains, widely used as a concentrated feed source in animal nutrition. In addition, the nutritional values of seeds with bracteole were determined to be of the best quality according to roughage quality standards. In the study, with increasing row spacing, it was determined that the crude protein, NDF and ADL contents of the seeds increased. However, it has been observed that the quality values determined in different inter-row spacings do not restrict the use of seeds as a roughage resource. As a result, it has been shown that the seeds with bracteole produced by the *Atriplex nitens* plant, which can grow under arid and unsoiled conditions, can be used as an alternative roughage source for the feed quality characteristics examined. Besides, it was concluded that bracteole-peeled seeds can be used as a concentrated feed resource in the nutrition of farm animals. It was also thought that the secondary compounds of the seeds and their inclusion levels in animal rations in future studies would be useful to reveal.

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