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Comparison of Yield and Silage Quality of some *Sorghum Bicolor* L. Cultivars and Corn under Salinity Stress

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ABSTRACT

Sorghum is an excellent alternative forage to corn silage in unfavorable environmental conditions. In order to evaluate eight sorghum cultivars and one corn cultivar (S.C 704 as control) under salinity stress (EC: 10.8 ds/m in soil and 5 ds/m in water), a randomized complete block design with three replicates was used during 2017-2018 cropping season at Fajr Isfahan Agricultural and Livestock CO. research field. Seven morphological traits, forage yield, and dry matter (DM) were determined and 15 traits related to silage were measured after ensiling in a plastic cylinder. The results showed that the Hannibal and Pegah cultivars had the highest forage yield with an average yield of 56.9 and 53.4 tons/h, respectively, whereas corn had the lowest forage yield with an average of 20.5 tons/h under test conditions. Hannibal and Sucrose Photo one BMR cultivars had the highest DM with 26.7% and 26.6%, respectively. Corn silage had the highest amount of crude protein, non-fibrous carbohydrates, total digestible nutrients, digestible energy, metabolizable energy, net energy lactation, crude fat, and the lowest amount of ash, acidity, the insoluble fiber in acid detergent and insoluble fiber in neutral detergent. This is followed by Pegah cultivar with a slight difference. It seems that the Pegah cultivar due to higher fodder yield, same silage quality as corn, more tolerance to drought, salinity, and heat than corn, and considerably less water requirement is a suitable alternative for corn in many salinity and water-scarce regions of Iran.

Keywords: *Sorghum bicolor L.*, Abiotic stress resistant, Forage, Silage quality, Digestible nutrients, Improper cultivation conditions

INTRODUCTION

Climate change and variability will affect agriculture, forestry and food security in Iran. In order to see less damage, a different sustainable scenarios like changing the cropping calendar, cropping pattern, and cropping rotation based on climate index is needed. The historical data indicates that due to drought and reduction of semiarid production will be sharply reduced. Values indicated that agricultural areas are highly vulnerable to climate change. More than 82% of Iran's territory is located in the arid and semi-arid zone of the world (Amiri and Eslamian, 2010) and has arid periods with less precipitation and intense evapotranspiration (Nouri *et al.*, 2020). Due to negative climate changes, more areas will be affected by abiotic stresses such as drought and salinity. Salinity is one of the most important abiotic stresses that determine factors limiting crop production (Wassmann *et al.*, 2009, Rajabi Dehnavi *et al.*, 2020). According to previous reports, approximately 2.1% of dry land and 19.5% of all irrigated land are affected by salt stress, and these percentages continue to increase (Rajabi Dehnavi *et al.*, 2020). This occurred can be exacerbated by the transporting of the subsurface salts to the surface soil by capillary movement or drainage in dry-land systems in lousy quality irrigation water. Salinity affects crop growth and production, through complex traits such as osmotic stress, ion toxicity, mineral deficits, and physiological and biochemical defects (Wassmann *et al.*, 2009). Salt-making ion toxicity such as Na and chloride ions in the soil. The crop growth will be affected when these ions are absorbed in high concentrations by the plant roots and accumulate in their stems or leaves (Munns and Tester, 2008). To avoid the adverse effects of drought and salinity stress in arid and semiarid regions, the development of tolerant cultivars is essential challenge. Most of the livestock's requirement for protein and energy provided by forages (Bhattarai, 2019).

There are 6,983,244 cows and calves in Iran (Jihad, 2023), and Corn (*Zea mays* L.) is one of the primary sources of fodder for these animals. Corn silage is the principal feed ingredient of the beef and dairy industries in Iran. Maize silage is the most expendable feed type (Sarshad *et al.*, 2021) but Maize has a high water requirements (Smith and Frederiksen, 2000). The problem is that farmers are looking for an alternative product rather than the crops that require more water (Fernandez 1992). Sorghum (*Sorghum bicolor* L.) a C4 plant, have the potential to improve household food security because of its excellent adaptability to drought (Duodu *et al.*, 2003). In addition to suitable tolerance against drought and salinity stress than corn, sorghum is close to corn for nutritional composition (Daneshvar Rad *et al.*, 2023). Forage sorghum pearl millet can be a viable alternative to corn silage due to its lower water requirement and relatively drought tolerant nature compared to corn. Sorghum and pearl millet have an edge on performance in semi-arid environments over corn, but the silage quality of sorghum and pearl millet is somewhat poorer than corn (Bhattarai, 2019).

The current study aims is to investigate the comparison of yield and silage quality of some sorghum cultivars and one cultivar of corn as control under salinity stress in order to provide beneficial and functional recommendations to farmers.

MATERIALS AND METHODS

Eight sorghum cultivars included Hannibal, Pegah, Sucrose Photo, Hyperion, Athena, Phoenix, Freya and Juicy sweet and one cultivar of corn (S.C 704) as control were studied during the 2017-2018 cropping season at Fajr Isfahan Agricultural and Livestock CO. research field, located on the central part of Iran, Ardestan (latitude 24º 52' north and longitude 22º 33' east, altitude 1255 m above the sea level) with surface soils of sandy texture. The average annual precipitation is estimated to be 110 mm. The precipitation during the cropping season of the experiment was 0 mm.

Soil analysis

The macro and micro nutrients of the experiment site were measured (Table 1).

Table 1. The results of soil analysis of the experiment site

Factor	value	Factor	value
Carbon (%)	15	Lime (%)	16
Silicon (%)	10	Acidity	7.35
Sulfur (%)	75	Electrical conductivity or salinity (ds/m)	10.8
Gypsum (%)	0	Boron (mg/kg)	1.6
Absorbable potassium (mg/kg)	138	copper (mg/kg)	0.48
Absorbable phosphorus (mg/kg)	11.7	Manganese (mg/kg)	6.1
Nitrogen (%)	0.006	Zinc (mg/kg)	1.5
Organic carbon (%)	0.059	Iron (mg/kg)	2.5
Soil saturation percentage	25		

The experimental layout was conducted in a randomized complete block design with three replications. Sowing was done at six-row plots, 5 m length, and 0.75 m row spacing as 10 seeds per square meter density. The total water used till the grain filling stages was 8500 m3.

Measured traits

The number of tillers, the number of leaves per stem, the number of leaves per plant, the number of secondary stems, length of the panicle, height, forage yield, and dry matter (DM) were determined. Then the best cultivars included Hannibal, Pegah, Sucrose Photo one BMR and S.C 704 as control were separately ensiled in three plastic cylinders. The cylinders were opened after 85 days and the following traits were measured: Crude protein (CP), acid detergent-insoluble crude protein (ADICP), neutral detergent-insoluble crude protein (NDICP), acid detergent-insoluble fiber (ADF), neutral detergent-insoluble fiber (NDF), acid detergent lignin (ADL), non-fibrous carbohydrates (NFC), total digestible nutrients (TDN), digestible energy (DE), metabolizable energy (ME), net lactation energy (NEL), crude fat or ether extract (EE), ash and acidity (PH). The traits related to silage were measured in the laboratory of the Jihad Agricultural Research Center of Isfahan.

To assess the quality of sorghum silage, Flieg's point was calculated based on the DM content and pH value of the sorghum and S.C 704 silage (Sariçiçek and Kiliç, 2009).

Equation 1: *Flieg point = (220 + ((2 * DM) - 15) - (pH * 40))*

* Poor: 20-30 * Average: 30-50 * Good: 50-70 * Excellent: 70-90

Statistical analysis

After the normalization test, data were analyzed statistically. The analysis of variance (ANOVA) was conducted to verify the statistical differences among the eight sorghum cultivars and S.C 704 of corn based on agrimorphological and silage related traits using the SAS 9.1 software. Duncan's multiple range test (DMRT) at 5% probability levels was used for the mean comparisons.

RESULTS AND CONCLUSION

Results of ANOVA for yield, its components and morphological traits of sorghum cultivars and S.C 704 (Table 2) revealed significant differences among genotypes for yield, height, stem diameter (S.D), number of tillers (N.T), number of leaves per stem (N.L.S), number of leaves per plant (N.L.P), number of secondary stems (N.S.S) and the length of the panicle (L.P) which indicating the presence of genotypic variability, different responses of genotypes and possible selection genotypes for breeding programs.

To find the best cultivar(s), the mean comparison was made using Duncan's test at the 1% level. The results of the mean comparison show the diversity in the reaction of the cultivars to the prevailing conditions, which probably shows the distinctiveness of the internal mechanisms of the genotypes and the diversity in the level of gene activity. Based on the mean comparison of morphological and yield-related traits for sorghum varieties and S.C 704 (Table 3), Hannibal has the highest yield, height, stem diameter, number of tillers, number of leaves per stem, and number of leaves per plant. There was no significant difference between Pegah and Hannibal for yield and stem diameter. S.C 704 as a control had the lowest yield height, number of stem leaves, and stem diameter. Corn panicle length was longer than sorghum cultivars.

The analysis of macro and micro nutrients in the soil shows the extreme poverty of nutrients and high salinity of the farm (Table 1). Apart from drought, salinity is a major abiotic factor that, in addition to natural causes, has been exacerbated by increased poor anthropological activities (Amombo *et al.*, 2022). There is a negative relationship between salinity and different traits of sorghum including related yield traits and height. Based on the results reported in Table 3, Hannibal had the highest height (230 cm) which significantly higher than the rest of the genotypes. No significant difference was seen among Juicy sweet (202.7 cm), Freya (196.1 cm), Sucrose Photo (192.7 cm) Pegah (192.3 cm) and Hyperion (176.7 cm), although all these cultivars had significantly higher heights than S.C 704 (155.2).

The stem diameter was measured the maturity stage and at the second node. Hannibal had the thickest stem with a diameter of 2 cm and with Pegah (1.8 cm) grouped in class a. The diameter of Sucrose Photo (1.7 cm), Hyperion (1.7 cm), Juicy sweet (1.6 cm), and S.C 704 (1.6 cm), Athena (1.5 cm) did not differ significantly and they were placed in the b group. Phoenix and Freya had the thinnest diameter with 1.4 and 1.2 cm respectively. A thinner stem is more susceptible to lodging and irregular stem growth. The cultivar Freya, which had a thinner stem, had irregular growth. Although in general irregular growth or the so-called pitcher growth in sorghum is seen even in Pegah and KWS Hannibal cultivars that have a thicker stem, this is more common in cultivars with a thinner stem. Irregular growth of the stem disrupts in the harvesting operation. Because the lower part of the stem lies on the ground, that part will not enter the opening of the chopper and will not be harvested, and as a result, it will waste the produced fodder.

Hannibal and Sucrose Photo with an average of 15.1 and 14.5, and Phoenix with 10, had the highest and lowest number of leaves per stem at the maturity stage, respectively. More green leaves at the time of harvest can be considered an advantage due to the role of leaves in photosynthesis, production of energy and dry matter, preservation of greenness and necessary humidity at the time of harvest.

Athena and Freya had more secondary stems with 3.8 and 2.9 stems, respectively and S.C 704, Pegah and Hannibal had no secondary stems. The number of leaves per plant is also higher in cultivars with more secondary stems. Secondary tillering and stemming can be analyzed from two perspectives as follows. On the one hand, considering that the growth of tillers and secondary stems is later than the main stem, they are behind the main stem in terms of growth. Therefore, when the main stem is ready to be harvested, the other stems differ in a growth spectrum from panicle emergence to pollination, milky and pulpy. As a result, there is a kind of non-uniformity in handling in these farms, which makes it a bit confusing to determine the right time to harvest these cultivars. On the other hand, in cultivars with high tillering ability, the energy is divided in different stems, and as a result, it reduces the growth of the main stem. It seems that having a primary and strong stem is better than having several weak stems, and mechanized harvesting of single-tiller varieties is easier than varieties with more tillers. Therefore, in order to make sorghum fields more uniform and to facilitate harvesting operations, it is suggested to plant sorghum with a higher density so that the single-stem plant grows as much as possible. Salt stress causes disrupts ionic homeostasis and cusses phytotoxicity, osmotic stress cause physiological drought, and photosynthesis disruption which causes nutrient imbalance (Gupta and Huang, 2014). Tolerant plants have developed an intricate and systematic antioxidant system at the genetic and physiological levels to optimize their conditions. The experiment was carried out in salty conditions and due to the low humidity (less than 10%), high temperature (about 50 degrees Celsius), strong and hot winds, poor texture and quality of the soil and low water quality, the occurrence of thermal stress was inevitable. Salinity stress increases the concentration of soluble salts in the root environment and as a result, increases the osmotic potential of the soil, which significantly reduces the absorption of nutrients. Salinity and heat stress has affected the potential of sorghum and corn cultivars. The result of these stresses has resulted in the reduction of growth and various traits in genotypes, especially corn. It has been reported that salinity and drought decrease leaf surface, carbon absorption, stem height and dry matter production (Velikova *et al.*, 2000). Salinity stress caused a decrease in vegetative traits in sorghum plants (Lacerda *et al.,* 2003). Robinson *et al.,* (2004) reported the reduction of biomass of 10 types of forage plants under salt stress conditions. S.C 704 biomass was significantly reduced under experimental conditions. Sorghum cultivars were less affected by adverse environmental conditions.

Silage related traits

Due to some limitations, it was not possible to evaluate silage related traits for all cultivars, therefore for that purpose the best cultivars of sorghum in terms of yield and related traits included Hannibal, Pegah, Sucrose Photo and S.C 704 as control were selected and separately ensiled. According to ANOVA for silage related traits (Table 4), there was statistically significant difference among genotypes for Dry matter (DM), Crude protein (CP), acid detergent-insoluble crude protein (ADICP), neutral detergent-insoluble crude protein (NDICP), acid detergent-insoluble fiber (ADF), neutral detergent-insoluble fiber (NDF), acid detergent lignin (ADL), non-fibrous carbohydrates (NFC), total digestible nutrients (TDN), digestible energy (DE), metabolizable energy (ME), net lactation energy (NEL), crude fat or ether extract (EE), ash and acidity (PH).

The S.C 704 has higher mean values related to crude protein fibrous carbohydrates, total digestible nutrients, digestible energy, metabolizable energy, net lactation energy and ether extract. Sucrose Photo and Pegah cultivars showed no difference one another for most of these traits, but Hannibal showed the lowest mean for these traits (Table 5). Based on results of mean comparison (Table 5) the S.C 704 has lower mean values related to acid detergent-insoluble fiber, neutral detergent-insoluble fiber, Ash and pH while Hannibal cultivar has the highest value for these traits. The presence of lactic acid producing bacteria, having enough soluble sugars (at least 80 grams per kilogram of dry matter) and having low buffering power are among the necessary conditions for silage. This condition is found in corn. In the Pegah variety, due to having low amounts of insoluble fibers in a neutral detergent, lignin and buffering power (which has minimal resistance to pH changes) and relatively high non-fibrous carbohydrates, it has almost the same conditions. The more dry matter will increase the quality of silage until it prevent springy (30-35% of dry matter). According to the average comparison table (Table 5), there is no significant difference between the three sorghum cultivars for dry matter, although they produced more dry matter than S.C 704. Crude protein is one of the most important indicators of fodder quality. Corn with an average of 9% has significantly the highest amount of crude protein, and Sucrose photo, Hannibal, and Pegah had the lowest amount with 7.9, 7.5, and 7.2 percent protein, respectively. The insoluble fiber in neutral detergent is another important factor that should be considered in nutrition. The digestibility of NDF is inversely related to the amount of lignin. In the present study, the amount of lignin in Hannibal was significantly differed from other genotypes. Pegah and S.C. 704 did not show a significant difference for

NDF. Among the features of a desirable plant for silage are: having high non-fermentable fibrous carbohydrates (NFC), low buffering capacity and lack of resistance to acidification. The amount of NFC in corn silage and Pegah is significantly higher than Sucrose and Hannibal cultivars, which is an effective factor in significantly reducing the acidity of corn and Pegah silage compared to the other two varieties. On the other hand, ash (anions and cations) as an index of buffering capacity was significantly higher in Hannibal and Sucrose cultivars than in Pegah and Corn cultivars, which indicates the low capacity of these two cultivars for silage. The acidity in S.C704 and Pegah is four and it is significantly lower than the other two varieties of sorghum. More non-fibrous carbohydrates and lower buffering capacity (ash) effectively reduce pH and thus increase silage quality. S.C 704 and Pegah cultivars have the most suitable value for these traits, and Hannibal was the weakest genotype. S.C 704 had the lowest amount of ash with 8.5% and the Pegah was grouped in the second class with (9.8%). Hannibal and Sucrose Photo were grouped in the third and fourth classes with values of 11.1% and 11.8%, respectively. From these results, it can be concluded that under water-stress conditions, Pegah cultivar can produce a higher silage yield with acceptable nutrient quality. However it cannot exceed the nutrient quality of corn for silage.

The net milking energy is a factor that determines the usefulness of silage for feeding dairy cows. Based on this index, as expected, S.C 704 with 1.4 Mcal/kg accounted for the highest net lactation energy and Pegah was grouped in second with 1.3 Mcal/kg. Considering that the net milking energy was determined in the current study under laboratory conditions, and on the other hand, fiber digestibility (NDF) is also a very important factor in dairy cattle feed consumption, so the feasibility of using Pegah silage in The ration of high production cows can be considered after conducting field tests and checking the performance of these cows. Therefore, it seems that Pegah silage can be used in feeding low milking cows, medium milking cows, calves and non-milking cows. The amount of total energy/ha that enters the livestock system was calculated by affecting the amount of net milking energy in the formula. Based on the results presented in Table 5, it was found that under the conditions governing the experiment, the amount of energy entered by sorghum into the animal husbandry system is significantly higher than that of corn. The Pegah cultivar produces the highest amount of energy with the amount of 16606 Kj/ha, and the 704 corn produces the lowest amount of energy with the amount 16606 Kj/ha.

Calculated of Flieg's point (Table 6) showed that the quality of silage of sorghum cultivars and S.C 704 was excellent and ranked 78.4 to 94.2. Pegah with 94.2 has the best quality and S.C 704 (92.4), Sucrose Photo (82.2) and Hannibal (78.4) had lower silage quality, respectively. It should be noted that no additives were added to the sorghum silages that help the fermentation process and thus improve the quality of the silage. Therefore, it seems that using supplements and other additives can also improve the quality of sorghum silage.

The importance of sorghum as a forage crop in saline areas has yet to be fully realized. Despite intraspecific variation in salt tolerance, sorghum is generally moderately salt-tolerant, and its productivity in saline soils can be minimal. As a promising fodder crop for saline areas, classic phenotype-based selection methods can be integrated with modern -omics in breeding programs to address salt tolerance and production simultaneously. Like other plants, sorghum has evolved a complex but efficient coping mechanism consisting of the antioxidant enzyme machinery, ionic homeostasis, osmotic adjustment, photosynthesis rearrangement, and hormonal and transcriptional regulation (Amombo *et al.*, 2022).

Wide intraspecific tolerance levels and performance and the complexity of soil salinity are partly to blame for limited research in forage sorghum (Negrao *et al.*, 2017). However, recent developments and breakthroughs in plant phenotyping and genotyping offer high potential for identifying and selecting salt-tolerant sorghum with high forage productivity and incorporating them with advanced breeding programs. In Iran, the lack of fodder is one of the main livestock issues, so the future of the beef and dairy industries is challenged by the diminishing irrigation water. This could diminish the economic growth of Iran. Because sorghum is known for its ability to tolerate drought, salinity and heat, which enables them to produce high forage yields with less water compared to corn, it can be said that in the future, sorghum will likely replace much of the corn silage crop in the some areas, where groundwater is declining rapidly and also is a potential alternatives to corn silage in saltier areas.

Table 2. Analysis of variance for yield, its components and morphological traits of sorghum cultivars and S.C 704

S.V	df	mean square							
		yield	Height	S.D	N.T	N.L.S	N.L.P	L.P	N.S.S
Cultivar	8	379.4^{*}	2040.6^{**}	0.1^{**}	0.1^{ns}	9.5^{**}	35^{ns}	245.7^{**}	6.5^{**}
Replication	2	28.5	294.3	0.01	0.2	0.4	14.8	14.4	0.0
Error	16	36.1	188.6	0.001	0.1	0.9	32.8	15.5	0.3
cv (%)		14.7	7.5	9	31.1	7.7	35.1	14.3	51.5

^{ns}, * and **: Non significant, significant at the 5% and 1% probability levels, respectively. Stem diameter (S.D), the number of tillers (N.T), the number of leaves per stem (N.L.S), the number of leaves per plant (N.L.P), the number of secondary stems (N.S.S), the length of the panicle (L.P)

Table 3. Mean comparison of yield, its components and morphological traits of sorghum cultivars and S.C 704

Cultivars	traits											
	Yield (ton/h)		Height (cm)		S.D(cm)		N.L.S		L.P		N.S.S	
Hannibal	56.9	a	230	a	2	a	15.1	a	17.2	e	0	c
Pegah	53.4	ab	192.3	b	1.8	ab	12.1	bc	19.6	de	0	c
Sucrose Photo	45.1	bc	192.7	b	1.7	cb	14.5	a	27.9	c	0.7	c
Hyperion	44.9	bc	176.7	bc	1.7	bc	12	bc	29.3	c	0.2	c
Athena	43.9	bcd	166.9	cd	1.5	cb	11.3	bcd	23	cde	3.8	a
Phoenix	35.8	cd	145.1	d	1.4	cd	10	d	22.7	cde	2.2	b
Freya	33.6	d	196.1	b	1.2	d	10.4	cd	37.4	b	2.9	ab
Juicy sweet	33.1	d	202.7	b	1.6	bc	12.7	b	25.7	cd	0.7	c
S.C 704	20.5	e	155.2	cd	1.6	cb	10.6	cd	45.9	a	0	c

Means, in each column, followed by at least one letter in common are not significantly different at the 5%probability level-using Duncan's Multiple Range Test. Stem diameter (S.D), the number of tillers (N.T), the number of leaves per stem (N.L.S), the number of leaves per plant (N.L.P), the number of secondary stems (N.S.S), the length of the panicle (L.P)

Table 4. Analysis of variance for silage traits of sorghum cultivars and S.C 704

	df	(DM)	(CP)	(ADICP)	(NDICP)	(ADF)	(NDF)	(ADL)	(NFC)	(TDN)	(DE)	(ME)	(NEL)	(EE)	(Ash)	(pH)	Energy
		Mean squares															
cu	3	6.7**	2**	0.4**	0.3**	52.9**	132**	9.9**	153.1**	117.1**	0.2**	0.2**	0.1**	0.4**	6.3**	0.2**	60595684**
rep	2	1.9	0.1	0.03	0	3.4	2.9	0.2	5.3	2.1	0	0	0	0	0.1	0	1467709
error	6	1.3	0.1	0.03	0.1	0.9	2.6	1.2	4.1	3.5	0	0	0	0	0.2	0	12169723
cv (%)	-	4.6	4.1	19.6	13.9	3	2.9	1.2	7.7	3.4	3.4	4.2	3.6	4.7	3.8	1.9	25.9

ns, * and **: Non significant, significant at the 5% and 1% probability levels, respectively. Dry matter (DM), Crude protein (CP), acid detergent-insoluble crude protein (ADICP), neutral detergent-insoluble crude protein (NDICP), acid detergent-insoluble fiber (ADF), neutral detergent-insoluble fiber (NDF), acid detergent lignin (ADL), non-fibrous carbohydrates (NFC), total digestible nutrients (TDN), digestible energy (DE), metabolizable energy (ME), net lactation energy (NEL), crude fat or ether extract (EE), ash and acidity (PH).

Table 5. Mean comparison of variance for silage traits of sorghum cultivars and S.C 704

Traits		Hannibal		Pegah		Sucrose Photo		S.C 704	
		Cultivars							
DM	%	26.7	a	24.6	ab	26.6	a	23.7	b
CP	%	7.5	bc	7.2	c	7.9	b	9	a
ADICP	%	1.3	a	0.9	a	1.1	a	0.4	b
NDICP	%	2.1	a	2.3	a	1.9	ab	1.5	b
ADF	%	35.9	a	27.3	c	32.2	b	27.2	c
NDF	%	63.5	a	51.3	c	56.7	b	48.5	C
ADL	%	9	a	6.5	b	5.7	b	4.7	B
NFC	%	18	c	31.8	a	22.9	b	32.8	A
TDN	%	47.5	c	56.5	b	54.3	b	62.6	A
DE	Mcal/kg	2.1	c	2.5	b	2.4	b	2.8	A
ME	Mcal/kg	1.7	c	2.1	b	2	b	2.3	A
NEL	Mcal/kg	1	c	1.3	b	1.2	b	1.4	A
EE	%	2	c	2.1	c	2.6	b	2.8	A
Ash	%	11.1	a	9.8	b	11.8	a	8.5	C
pH	-	4.5	a	4	c	4.4	b	4	C
D.M*Yield	kg/ha	15261	a	13163	a	12031	a	4869	B
Energy	Kj/ha	15931	a	16606	a	14561	a	6873	B

Means, in each column, followed by at least one letter in common are not significantly different at the 5% probability level-using Duncan's Multiple Range Test. Dry matter (DM), Crude protein (CP), acid detergent-insoluble crude protein (ADICP), neutral detergent-insoluble crude protein (NDICP), acid detergent-insoluble fiber (ADF), neutral detergent-insoluble fiber (NDF), acid detergent lignin (ADL), non-fibrous carbohydrates (NFC), total digestible nutrients (TDN), digestible energy (DE), metabolizable energy (ME), net lactation energy (NEL), crude fat or ether extract (EE), ash and acidity (PH).

Table 6. The quality of sorghum and S.C. 704 silage based on Flieg's point

num	Cultivars	Silage quality
1	Pegah	94.2
2	S.C 704	92.4
3	Sucrose Photo	82.2
4	Hannibal	78.4

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