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Fodder and grain quality of Pearl millet (*Pennisetum glaucum* L.) under cutting management in saline irrigation water

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Abstract

The present study was undertaken to assess the production potential and quality of different pearlmillet accessions under saline environment. The experiment was conducted in Factorial RBD with treatments consisting 20 pearl millet accession and 2 cutting management. Irrespective of cutting management ICFH-15 recorded significantly highest value for total DM yield (15.3 t/ha), crude protein content (8.93%), EE (2.86%), ash content (10.08%) in fodder. Conversely to these aforesaid qualitative traits ICFH-15 recorded significantly lowest value for average NDF (64.20%) and ADF (35.50%) content. Two cuttings at 50 and 110 DAS resulted in maximum DM content (19.47%), Total Dry matter yield (12.16 t ha^{-1}), crude protein content (8.03%), and ADF content (37.56%), however the maximum Ether extract (3.06%) and NDF content (68.69%) observed under three cuttings each at 50,80 and 110 DAS treatment. The interaction between accessions and cutting management was found significant for total DM yield. In general, crude protein content and Ether extract decreased with advancement of crop maturity reverse to these traits DM, Ash, ADF and NDF content increased with maturity crop. The grain quality of accession ICFH-15 was recorded maximum crude protein content (10.43%); ether extract content (4.56%) and ash content (3.68%) than rest others. ICFH-15 resulted in lowest value of NDF (31.43%) and ADF content (3.12%). Concentrations of various macro and micro nutrients were estimated in grain. Among different accessions, ICFH -15 proved significantly superior with the maximum Ca (193.63 mg/kg), Mg (1208.13 mg/kg), Fe (68.82 mg/kg), Zn (74.67 mg/kg), Cu (9.19 mg/kg) and Mn (16.43 mg/kg) content in grains. Therefore, accession ICFH -15 and among cutting management strategies, single cut for green fodder followed by harvest for grain might be adapted for getting higher dry matter yield with better quality under saline environment.

Keywords: pearlmillet accessions, cutting management, fodder and grain quality

Introduction

Livestock production is backbone of livelihood of the marginal and sub marginal farmers especially in rural areas. Though our country ranks first in terms of milk production with the amount of 155.5 million tonnes (Anonymous, 2016) [2]; but the productivity of our animals is hardly 40-60% of world's average productivity. The lower productivity of animals under Indian condition mainly accounted due to deficit supply of green fodder. Because, country has only 4.4 per cent of the cultivated area under fodder crops with an annual total forage production of 833 million tons. (Kumar *et al.* 2012) [9].

Abiotic stresses resulting from water deficit, high irrigation water salinity, and drought are identified as major causes to bring down yield and quality of cultivated forage crops (Inze and Van Montague, 1995) [6]. Therefore, inadequate supply of good quality water for irrigation is a major factor limiting crop production in arid and semi-arid regions of world in general and India in particular. So, better alternative in no other than to safe use of poor quality water for augmenting irrigation requirement. Another possibility is through exploring the opportunities for better utilization of existing farming systems, utilizing marginal, sub marginal dry lands and problematic soils for developing fodder resources. In this context, Pearl millet (*Pennisetum glaucum* L.) is a promising dual purpose (fodder and grain), short duration, quick growing crop with good salinity tolerant characteristics, therefore has an advantage over others cultivated fodder in salt affected areas (Kumawat *et al.* 2016) [12]. Being any time forage, with high tillering ability, high protein content (10-12%) and ratoon ability, unlike sorghum, can be grazed, or cut and fed at any growth stage, as it has no HCN content thus making it as an outstanding fodder crop in present required situations. Pearl millet has been also reported to have high tolerance to salinity and drought thus it can serve as an important crop to ensure good quality fodder for animals in the arid and semi-arid regions of India and elsewhere in the world under similar agro ecologies (Kulkarni *et al*. 2006) [8].

Majority of recommended fodder pearlmillet varieties were evolved and released based on their single cut performance, but now the farmers are willing to go for 2-3 cuts to fulfill their need. Development of intra-specific forage hybrids that combine the ability for repeated harvests (multicuts), earliness to first harvest, short harvesting intervals, quick regeneration, the in-built tillering potential, high green fodder yield, high quality factors and low anti-nutritional constituents like oxalic acid and nitrates has tremendous opportunity to improve pearl millet as a forage crop. International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), is a pioneer research institute continuous working for explore the genotypic variability of vegetative-stage salinity and drought tolerance. ICRISAT has collected more than 21000 accessions of pearlmillet having land races and breeders' products. These accessions revealed considerable variability for various fodder and quality components such plant height, leaf to stem ratio, number of leaves, tillers, protein, dry matter and mineral content. Therefore, present study was conducted to assess the production potential of 20 Pearl millet accessions derived from ICRISAT with two cutting management (as dual and multicut purpose) under saline irrigation water with major emphasis on qualitative response.

Material and Methods

This study was carried out at ICAR-CSSRI, Experimental farm, Nain (29°19' N, 76°47'E and 230.5 m above the mean sea level), Panipat, Haryana. The climate of the area is semi-arid with a mean annual rainfall of 678 mm, 70-80% of which is received during the months of July-September. The mean minimum, maximum temperature and total rainfall during this study was 13.9 °C, 34.3 °C and 523 mm, respectively. In addition to rainfall, supplemental irrigations of saline water (EC 6.0 dS/m) were scheduled at 1.2 ID/CPE to meet the crop water requirement throughout the growing period. The experiment was conducted in Factorial RBD with three replications. The imposed treatments under study were 20 pearl millet accessions (ICFH 1, ICFH 2, ICFH 3, ICFH 4, ICFH 5, ICFH 6, ICFH 7, ICFH 8,ICFH 9, ICFH 10, ICFH 11, ICFH 12, ICFH 13, ICFH 14, ICFH 15, ICFH 16, ICFH 17, ICFH 18, ICFH 19, ICFH 20) to access dual purpose and multicut fodder production potential in two cutting management i.e. for dual purpose (C_1-cutting at 50 and 110 DAS for grain) and for multicut (C_2-cutting at 50, 80 and 110 DAS). The soil of experimental site was sandy loam in texture with 8.3 pH, Walkley–Black C (0.30%), ECe(6.65 dS/m), KMnO4 oxidizable N (130.4 kg/ha), 0.5 M NaHCO3 extractable P(11.6 kg/ha) and 1 NH4OAC extractable K (248.4 kg/ha). Seed rate 12 kg ha^{-1} and Row spacing: 30 cm×10 cm was adopted under this study. A common dose of nutrients amounting 120 kg N + 60 kg P_2O_5 + 40 kg K_2O were applied in all treatments. The 1/3rd N and whole P_2O5 and K_2O was applied as basal, while remaining 2/3rd N was top dressed as urea in two equal splits at 1st cutting and 30 days after 1st cutting. In view of best weed management, all the plots were manually weeded as per the requirement during the complete crop cycle. Crop was harvested manually at 8-10 cm above the ground level. At each harvest Plant samples (1.0 kg fresh weight) were collected to analyse quality parameters. To assess DM contents, all samples were dried in a hot air oven at 65°C for at least 48 h until a constant weight was reached. The dried samples were milled to pass through a 2 mm sieve for quality evaluation. The crude protein (CP), crude fat (EE), and ash contents were analyzed using AOAC (2005) [3] procedures. The neutral detergent fibre (NDF) and acid detergent fibre (ADF) concentrations were determined using the methods of Van Soest *et al.,* (1991). The representative grain sample (250 gram weight) was taken and the samples were dried in hot air oven and ground to pass through 2 mm sieve for determination of proximate analysis (AOAC, 2005) and cell wall constituents (Van Soest, 1991) [20]. The nutrient content in grain were determined by acid extraction and analyzed in atomic-absorption spectrophotometer. All data recorded were analyzed with the help of analysis of variance (Gomez and Gomez 1984)[5] for Factorial RBD and comparisons were made according to DMRT using SAS 9.3 software (SAS Institute, Cary, NC). The least significant test was used to decipher the main and interaction effects of treatments at 5% level of significance ($P<0.05$).

Results and Discussion

Dry matter (DM) content of pearl millet accessions under different cutting management in saline environment was measured and data presented in table 1. Average dry matter content varied between 18.57 to 20.67%. Dry matter content was not influenced significantly by any of the treatments and their interactions at all the stages of observation.

Periodic dry matter yield was recorded according to cutting management treatment at 50, 80 and 110 DAS (Table 1). At 50 and 80 DAS, dry matter yield was not influenced due to cutting management, however, significant variations were observed due to interaction of accessions and cutting management. The maximum dry matter yield was observed in ICFH-15(8.00 t/ha) followed by ICFH-16(7.23 t/ha) and minimum in ICFH-7 (5.26 t/ha) at 50 DAS. While at 80 DAS, the maximum dry matter yield was observed in ICFH-03 (4.24 t/ha) followed by ICFH-01 (3.86 t/ha) and minimum in ICFH-19 (2.84 t/ha). At 110 DAS The highest and lowest dry matter yield was noted in ICFH-15(7.16 t/ha) and ICFH-04 (4.37 t/ha) respectively under C_1.While under C_2 treatments ICFH-03 (2.86 t/ha) and ICFH-20 (1.29 t/ha) resulted highest and lowest value respectively for dry matter yield.

A perusal of data indicated that total dry matter yield was influenced significantly by both main effect of accessions and their interactions with cutting management. Under cutting management treatments, significantly higher dry matter yield was found in C_1 (12.16 t/ha) in comparison to C_2 (11.40 t/ha). The interaction between accessions and cutting management was found significant and the highest and lowest value for dry matter yield was recorded in ICFH-15(15.3 t/ha) and ICFH-04(9.66 t/ha) under C_1 treatment while under C_2 treatment highest and lowest value for this parameter was observed in ICFH-15(14.37 t/ha) and ICFH-07(9.69 t/ha). When we critically examine the interaction effect of cutting and accessions the order of dry matter yield at C_1 was ICFH-15> ICFH-17> ICFH-14> ICFH-16> ICFH-18> ICFH-19> ICFH-20> ICFH-11> ICFH-12> ICFH-06> ICFH-13> ICFH-08> ICFH-10> ICFH-09> ICFH-03> ICFH-05> ICFH-01> ICFH-02> ICFH-07> ICFH-04 while at C_2 it was ICFH-15> ICFH-03> ICFH-16> ICFH-01> ICFH-06> ICFH-13> ICFH-04> ICFH-12> ICFH-02> ICFH-18> ICFH-10> ICFH-17> ICFH-08> ICFH-14> ICFH-05> ICFH-19> ICFH-20> ICFH-11> ICFH-09> ICFH-07. The differential response among the accessions for dry matter yield may be attributed due to variation in genetic make-up. Genotypic variation among accessions resulted in differential response for plant height, tillering pattern, leaf: stem ratio which leads to variation in green fodder yield and finally in dry matter yield. The accession in which Significantly lower dry matter yield noted might be due to inability to cope up with the higher load of salt under saline irrigation water which restricted the root growth of plants that in turn reduced the uptake of nutrients leading to leaf chlorosis that reduces the photosynthetic potential of crops which ultimately leads to lower dry matter yield. Irrespective of the accessions C$_1$ treatment proved superior. This may be attributed due single cut for green fodder followed by harvest for grain purpose facilitates the more opportune time for growth and development. Frequent cutting also reduces the possibility of photosynthesis and inhibits nutrient assimilation and reduces the carbohydrate reserve, which affects the biomass production of the plants and ultimately dry matter yield. These results are in conformity with the findings of [(Phogat *et al.* 2012) [18]; (Shashikala *et al.* 2013) [19]; (Manjanagouda *et al.* 2015) [15] and (Makarana *et al.* 2017^a) [14].

Crude protein content of any fodder crop is a major quality trait as it is needed for overall development of all dairy animals. Crude protein content (average of 50, 80 and 110 days harvest) of different pearl millet accessions and cutting management (Table 2) showed that average crude protein content varied between 6.24 to 9.11%. In general, it decreased with advancement of crop maturity from 10.11% at 1st cut to 5.24% at 3rd cut.

Table 1: Dry matter content (%) and yield (t/ha) of pearl millet fodder as influenced by accessions and cutting management

Treatment VxC	DM (%)									Dry matter yield (t/ha)								
	50 DAS			80 DAS	110 DAS		Average			50 DAS			80 DAS	110 DAS		Total DMY (t/ha)		
	C1	C2	Mean	C2	C1	C2	C1	C2	Mean	C1	C2	Mean	C2	C1	C2	C1	C2	Mean
ICFH-1	18.76	18.45	18.6	19.78	19.57	20.28	19.16	19.5	19.33	5.71	5.70	5.71^{abc}	3.86^{bc}	4.91^{abc}	2.75^{cd}	10.62^{abc}	12.32^{def}	11.47^{bcd}
ICFH-2	18.64	17.9	18.27	19.02	19.33	19.95	18.99	18.96	18.97	5.53	5.29	5.41^{ab}	3.77^{abc}	4.73^{ab}	2.39^{abcd}	10.26^{ab}	11.45^{bcd}	10.86^{bc}
ICFH-3	18.58	19.33	18.95	20.78	19.25	19.98	18.91	20.03	19.47	6.04	6.18	6.11^{abcd}	4.24^{c}	5.07^{abcd}	2.86^{d}	11.11^{abcde}	13.27^{fg}	12.19^{de}
ICFH-4	18.83	19.17	19	19.23	19.27	19.14	19.05	19.18	19.11	5.28	5.53	5.41^{ab}	3.73^{abc}	4.37^{a}	2.26^{abcd}	9.66^{a}	11.52^{bcd}	10.59^{ab}
ICFH-5	18.82	17.66	18.24	20.58	20.17	20.14	19.49	19.46	19.48	5.50	5.18	5.34^{ab}	3.78^{abc}	5.40^{abcde}	1.72^{abc}	10.90^{abcd}	10.68^{abc}	10.79^{ab}
ICFH-6	19.05	18.71	18.88	19.74	19.26	19.85	19.16	19.43	19.3	6.51	6.88	6.69^{cd}	3.23^{ab}	5.82^{bcdef}	1.57^{ab}	12.33^{defghi}	11.67^{cde}	12.00^{de}
ICFH-7	19.05	18.88	18.97	18.58	18.86	19.61	18.95	19.02	18.99	5.16	5.36	5.26^{a}	3.02^{ab}	4.72^{ab}	1.31^{a}	9.88^{a}	9.69^{a}	9.78^{a}
ICFH-8	20.05	19.18	19.62	20.08	20.64	19.75	20.34	19.84	20.09	6.08	6.04	6.06^{abc}	3.42^{abc}	5.98^{cdef}	1.44^{a}	12.06^{cdefgh}	10.90^{abcd}	11.48^{bcd}
ICFH-9	18.65	17.93	18.29	18.78	19.3	20.45	18.97	19.05	19.01	5.84	5.52	5.68^{abc}	2.85^{a}	5.62^{bcdef}	1.63^{abc}	11.46^{bcdef}	10.00^{ab}	10.73^{ab}
ICFH-10	18.51	18.24	18.38	18.37	18.63	19.28	18.57	18.63	18.6	6.00	6.20	6.10^{abc}	3.23^{ab}	5.91^{cdef}	1.94^{abcd}	11.90^{cdefg}	11.37^{bcd}	11.64^{bcde}
ICFH-11	19.07	17.37	18.22	18.68	19.77	21.47	19.42	19.18	19.3	6.36	5.74	6.05^{abc}	2.92^{ab}	6.26^{efg}	1.70^{abc}	12.62^{efghi}	10.37^{abc}	11.49^{bcd}
ICFH-12	19.27	18.93	19.1	20.11	21.11	19.5	20.19	19.52	19.85	6.18	6.36	6.27^{abcd}	3.46^{abc}	6.28^{efg}	1.66^{abc}	12.47^{efghi}	11.48^{bcd}	11.97^{cde}
ICFH-13	18.84	19.54	19.19	20.23	19.19	20.83	19.02	20.2	19.61	6.28	6.42	6.35^{abcd}	3.40^{abc}	5.95^{cdef}	1.80^{abcd}	12.24^{defgh}	11.61^{bcde}	11.92^{cde}
ICFH-14	19.96	18.08	19.02	20.02	21.56	19.56	20.76	19.22	19.99	6.78	6.15	6.46^{bcd}	3.13^{ab}	6.78^{fg}	1.52^{ab}	13.56^{hij}	10.79^{abcd}	12.17^{de}
ICFH-15	20.28	19.68	19.98	20.78	21.7	21.5	20.86	20.49	20.67	8.14	7.87	8.00^{e}	3.87^{bc}	7.16^{g}	2.63^{bcd}	15.30^{k}	14.37^{g}	14.83^{g}
ICFH-16	19.4	19.36	19.38	19.73	19.33	20.95	19.37	20.01	19.69	7.09	7.36	7.23^{de}	3.47^{abc}	6.77^{fg}	2.23^{abcd}	13.86^{ij}	13.06^{efg}	13.46f
ICFH-17	20.01	18.35	19.18	19.02	20.87	20.34	20.57	19.24	19.9	7.15	6.33	6.74^{cd}	2.85^{a}	7.140^{g}	1.82^{abcd}	14.29^{jk}	11.00^{abcd}	12.65^{ef}
ICFH-18	18.24	19.03	18.64	19.56	20.44	19.1	19.34	19.23	19.29	6.52	6.70	6.61^{cd}	2.98^{ab}	6.59^{fg}	1.76^{abcd}	13.11^{ghij}	11.43^{bcd}	12.27^{de}
ICFH-19	18.14	17.79	17.97	19.21	19.5	18.74	18.82	18.58	18.7	6.54	6.16	6.35^{abcd}	2.84^{a}	6.21^{defg}	1.61^{abc}	12.75^{fghi}	10.61^{abc}	11.68^{bcde}
ICFH-20	19.18	18.39	18.78	19.37	19.9	19.38	19.54	19.04	19.29	6.55	6.08	6.31^{abcd}	3.02^{ab}	6.18^{defg}	1.29^{a}	12.73^{fghi}	10.39^{abc}	11.56^{bcde}
Mean	19.07	18.6		19.58	19.88	19.99	19.47	19.39		6.26	6.15					12.16^{a}	11.40^{b}	

a,b,c values bearing different superscript in column differs significantly(p=0.05)

The accession ICFH-15 recorded highest values of CP (8.93%) followed by ICFH-16 (8.53%). Magnitude of variation in different accessions was observed with 43.11% between ICFH-15 (highest) and ICFH-7 (Lowest). Single cut for green fodder followed by harvest for grain purpose has recorded significantly higher (8.03%) average crude protein content with the magnitude of difference 6.08% as compared to the three cut for green fodder purpose (7.57%). The higher crude protein content in the single cut followed by harvest for grain was mainly due to the more number of leaves and higher nitrogen per cent in leaves ultimately increased crude protein content. Increased accumulation of carbohydrates and other structural material such as lignin and silica with advancement of crop maturity and reduction in leafiness could be attributed to decrease in the crude protein content with crop maturity. The difference among accessions may be due to the physico-genetic characteristics. The accessions which resulted in lower value for crude protein content may not have potential to alleviate the salt load in plant root zone which reduced the root area, lowers down the uptake of nitrogen by the plants which ultimately leads to lower crude protein content in plant biomass as it is essential for protein synthesis. The similar result was also reported by (Pathan *et al.* 2012) [17] and (Kumari *et al.* 2014) [11].

Ether extract (EE) content of pearl millet accessions under different cutting management is presented in table 2. Average ether extract content varied between 2.25 to 3.13%. Ether extract content was significantly influenced by the treatments. Like crude protein it also decreased with advancement of crop maturity from 3.78 at 1st harvest to 2.24% at 3rd harvest. The accession ICFH-15 recorded the highest EE (2.86%) whereas; ICFH 4 and ICFH-7 recorded lowest EE (2.65%); however the differences did not reach to the level of significance. Among the cutting management, C$_2$ recorded significantly higher value of average ether extract (3.06%) as compared to C$_1$ (2.45%) with the difference of 24.90%. The higher value for EE content in C$_2$ treatments may be due to more leafiness, regular chlorophyll development and shorter time availability conversion of sugar to cellulose as long chain polysaccharides, which is responsible for formation of fibre like structure. The accession with lower value of ether extract content may not have fully physiologically active in terms of chlorophyll and wax development under saline water irrigation which implies a lower capacity of leaf tissues for light harvesting and production of ether. The results of our experiment are in supported with the findings of [(Cop *et al.* 2009) [4]; (Kumar *et al.* 2015) [10] and (Makarana *et al.* 2017^a) [14]

Table 2: Crude protein content (%) and ether extract content (%) of pearl millet fodder as influenced by accessions and cutting management

Treatment VxC	CP (%)									EE (%)								
	50 DAS			80 DAS	110 DAS		Average			50 DAS			80 DAS	110 DAS		Average		
	C1	C2	Mean	C2	C1	C2	C1	C2	Mean	C1	C2	Mean	C2	C1	C2	C1	C2	Mean
ICFH-1	9.23	8.50	8.87^{abcde}	6.94^{abcd}	6.77^{bc}	5.97^{abc}	8	7.14	7.57^{abc}	3.49	3.48	3.63^{abcde}	2.86	1.38	2.79	2.44	3.04	2.74
ICFH-2	8.78	7.39	8.09^{defg}	6.76^{abc}	7.47^{cde}	6.85^{abcde}	8.13	7	7.56^{abc}	3.52	3.44	3.83^{de}	2.98	1.29	2.65	2.41	3.02	2.71
ICFH-3	8.47	8.89	8.68^{abcdef}	8.06^{def}	7.33^{c}	7.69^{de}	7.9	8.21	8.06^{bc}	3.39	3.65	3.78^{de}	2.83	1.52	2.96	2.46	3.15	2.8
ICFH-4	6.95	7.38	7.17^{defg}	6.39^{ab}	5.28^{a}	6.03^{abc}	6.12	6.6	6.36^{a}	3.39	3.61	3.88^{e}	2.69	1.19	2.74	2.29	3.01	2.65
ICFH-5	7.54	8.07	7.81^{defg}	6.76^{abc}	6.68^{bc}	6.05^{abcd}	7.11	6.96	7.04^{ab}	3.51	3.55	3.66^{bcde}	2.79	1.13	2.74	2.32	3.03	2.67
ICFH-6	9.63	9.23	9.43^{abcd}	7.30_{bcde}	8.71^{def}	5.46^{a}	9.17	7.33	8.25^{bc}	3.19	3.76	3.62^{abcde}	2.64	1.77	2.98	2.48	3.13	2.8
ICFH-7	6.60	6.70	6.65^{g}	6.08^{a}	5.89^{ab}	5.94^{abc}	6.25	6.24	6.24^{a}	3.25	3.73	3.71^{bcde}	2.55	1.24	2.88	2.25	3.05	2.65
ICFH-8	8.35	8.17	8.26^{cdef}	6.96^{abcd}	5.56^{ab}	6.42^{abcd}	6.96	7.18	7.07^{ab}	3.3	3.66	3.28^{a}	2.71	1.25	2.85	2.28	3.07	2.67
ICFH-9	7.36	8.12	7.74^{defg}	7.03^{abcde}	6.73^{bc}	6.71^{abcde}	7.05	7.29	7.17^{ab}	3.81	3.12	3.67^{bcde}	3.17	1.27	2.24	2.54	2.84	2.69
ICFH-10	9.58	9.46	9.52^{abcd}	$7.96^{de}f$	7.71^{cdef}	7.16^{bcde}	8.65	8.19	8.42^{bc}	3.66	3.47	3.41^{abc}	2.94	1.50	2.77	2.58	3.06	2.82
ICFH-11	9.34	9.17	9.26^{abcde}	7.21^{bcde}	7.85^{cdef}	5.32^{a}	8.6	7.23	7.91^{bc}	3.7	3.4	3.76^{cde}	3.05	1.32	2.56	2.51	3	2.76
ICFH-12	9.05	9.00	9.03^{abcde}	7.65^{cde}	6.79^{bc}	6.91^{abcde}	7.92	7.85	7.89^{bc}	3.36	3.69	3.57^{abcde}	2.74	1.40	2.94	2.38	3.12	2.75
ICFH-13	9.17	9.06	9.12^{abcde}	7.59^{cde}	7.38^{cd}	6.65^{abcd}	8.28	7.77	8.02^{bc}	3.54	3.53	3.56^{abcde}	2.91	1.36	2.80	2.45	3.08	2.77
ICFH-14	9.40	8.82	9.11^{abcde}	7.420^{bcde}	7.52^{cde}	6.69^{abcde}	8.46	7.64	8.05^{bc}	3.42	3.64	3.38^{ab}	2.81	1.50	2.93	2.46	3.13	2.79
ICFH-15	10.04	10.18	10.11^{a}	8.87^{f}	8.93^{f}	8.29^{e}	8.76	9.11	8.93^{c}	3.64	3.49	3.65^{bcde}	2.92	1.56	2.94	2.6	3.12	2.86
ICFH-16	9.81	9.69	9.75^{abcd}	8.10^{def}	7.91^{cdef}	6.79^{abcde}	8.86	8.19	8.53^{bc}	3.81	3.32	3.58^{abcde}	3.43	1.30	2.56	2.56	3.1	2.83
ICFH-17	9.68	9.46	9.57^{abcd}	8.150^{ef}	7.66^{cdef}	7.44^{cde}	8.67	8.35	8.51^{bc}	3.68	3.42	3.67^{bcde}	3.29	1.34	2.70	2.51	3.14	2.82
ICFH-18	9.93	9.74	9.84^{ab}	7.86^{cdef}	8.83^{ef}	5.74^{ab}	8.92	7.78	8.35^{bc}	3.73	3.42	3.53^{abcde}	3.05	1.38	2.71	2.56	3.06	2.81
ICFH-19	9.81	9.46	9.64^{abcd}	7.68^{cde}	8.03^{cdef}	5.85^{abc}	8.92	7.66	8.29^{bc}	3.57	3.5	3.50^{abcd}	2.96	1.45	2.84	2.51	3.1	2.81
ICFH-20	8.41	8.52	8.47^{bcdef}	7.41^{bcde}	7.24^{c}	7.34^{bcde}	7.83	7.76	7.79^{bc}	3.62	3.37	3.74^{bcde}	2.89	1.40	2.62	2.51	2.96	2.74
Mean	8.86	8.75		7.41	7.31	6.57	8.03^{a}	7.57^{b}	7.8	3.53	3.51					2.45^{a}	3.06^{b}	

a,b,c values bearing different superscript in column differs significantly(p=0.05)

Ash content of any fodder crop reflects its mineral matter. Increased ash content in fodder with any agronomic intervention is welcome if concentration of major cations (Na^+, $Ca^{2+}$and Mg^{2+}) and anions ($Cl^-$and SO_4^{2-}) increases in required proportion which favors the animal health. In contrast to crude protein and ether extract it increased with advancement of crop maturity from 8.27% at 1st harvest to 10.12% at 3rd harvest. Average ash content varied between 8.89 to 10.12%. Among different accessions, ICFH-15 accumulated the significant highest (10.08%) and ICFH-07 recorded lowest (9.07%) ash content, however, no significant differences were observed between cutting management treatments. The interaction effect of cutting and accessions for average ash content was significant, with C_1 management trend, ICFH-16> ICFH-17> ICFH-18> ICFH-15> ICFH-10> ICFH-19> ICFH-11> ICFH-06> ICFH-13> ICFH-14> ICFH-03>ICFH-20> ICFH-01> ICFH-09> ICFH-12> ICFH-02> ICFH-05> ICFH-04> ICFH-08> ICFH-07 was observed while with C_2 trend was found in order ICFH-15> ICFH-16> ICFH-17> ICFH-10> ICFH-12> ICFH-03> ICFH-19> ICFH-18> ICFH-06> ICFH-14> ICFH-02> ICFH-13> ICFH-08> ICFH-01> ICFH-09> ICFH-11> ICFH-20> ICFH-05> ICFH-04> ICFH-07. The variation among accessions for ash content might be due to difference in genetic potential for accumulation of salt in various plant organs. The accession which resulted in higher value for ash content might have higher uptake of the ions such as (Na^+, Ca^{2+} $Mg^{2+}Cl^-$ and SO_4^{2-}) under saline environment. Genotypic variations and higher ash content at later stage of dual purpose pearl millet under saline environment is also reported by (Al-Dakheel *et al.* 2015) [1]; Makarana *et al.* 2017^a) [14].

Average NDF content varied between 65.12 to 74.39% (Table 3). Average NDF content varied significantly among different accessions. Among different accessions ICFH-7 and ICFH-15 recorded the significantly highest (74.39%) and lowest (65.12%) respectively. The cutting managements, C_1 recorded significantly lower value of NDF (69.11%) as compared to C_2 (69.60%). The difference in genetic potential of accessions for making rigid and hard under stress environment might be reason for variation in NDF value. The accessions which obtained higher value of NDF content in saline condition and cutting treatment might be due to more accumulation and translocation of higher concentration of soluble salts that led to their increased deposition in cell wall, its constituents and thus containing higher NDF value. The results are in confirmative with the findings of (Yadav *et al.* 2007) [22] and (Noor *et al.* 2016) [16].

Table 3: Ash content (%) and NDF content (%)of pearl millet fodder as influenced by accessions and cutting management

Treatment VxC	Ash (%)									NDF (%)								
	50 DAS			80 DAS	110 DAS		Average			50 DAS			80 DAS		110 DAS	Average		
	C1	C2	Mean	C2	C1	C2	C1	C2	Mean	C1	C2	Mean	C2	C1	C2	C1	C2	Mean
ICFH-1	8.35	8.74	8.27	9.64	11.20	10.19	9.78	9.52	9.65^{ab}	69.00	66.80	67.90	65.90^{ab}	69.20^{bc}	67.70^{a}	69.10	66.80	67.95^{abc}
ICFH-2	8.41	8.76	8.62	9.76	10.75	10.53	9.58	9.68	9.63^{ab}	69.00	67.60	68.30	69.90^{bcdef}	69.40^{bc}	69.30^{ab}	69.20	68.93	69.06^{bcde}
ICFH-3	9.05	8.88	8.72	9.97	10.75	10.50	9.90	9.78	9.84^{ab}	66.70	67.30	67.00	68.70^{abcde}	68.40^{abc}	71.80^{abc}	67.55	69.27	68.41^{bcd}
ICFH-4	6.95	8.33	8.41	9.54	11.39	10.14	9.17	9.34	9.25^{ab}	71.30	69.60	70.45	76.30^{hi}	78.50^{f}	72.80^{abc}	74.90	72.90	73.90^{g}
ICFH-5	7.54	8.62	8.58	9.55	10.86	10.15	9.20	9.44	9.32^{ab}	69.60	68.50	69.05	71.20^{defg}	74.20^{def}	70.80^{abc}	71.90	70.17	71.03^{def}
ICFH-6	9.40	8.81	8.68	9.90	10.56	10.40	9.98	9.7	9.84^{ab}	66.40	65.70	66.05	66.80^{abc}	67.40^{ab}	70.00^{abc}	66.90	67.50	67.20^{abc}
ICFH-7	6.60	8.30	8.82	9.34	11.17	10.11	8.89	9.25	9.07^{a}	71.90	71.10	71.50	77.80^{i}	77.00^{ef}	74.10^{abc}	74.45	74.33	74.39^{g}
ICFH-8	7.36	8.64	8.62	9.64	10.86	10.41	9.11	9.56	9.34^{ab}	69.30	68.60	68.95	74.50^{ghi}	76.90^{ef}	72.30^{abc}	73.10	71.80	72.45^{fg}
ICFH-9	8.78	8.45	8.45	9.59	10.63	10.49	9.71	9.51	9.61^{ab}	69.10	68.30	68.70	72.10^{efg}	77.40^{f}	72.10^{abc}	73.25	70.83	72.04^{efg}
ICFH-10	9.58	9.03	8.33	10.01	10.54	10.51	10.06	9.85	9.96^{ab}	65.60	64.20	64.90	65.90^{ab}	67.30^{ab}	70.80^{abc}	66.45	66.97	66.71^{ab}
ICFH-11	9.23	8.74	8.61	9.61	10.81	10.14	10.02	9.5	9.76^{ab}	68.00	66.50	67.25	68.40^{abcde}	68.80^{abc}	71.80^{abc}	68.40	68.90	68.65^{bcd}

ICFH-12	8.47	8.85	8.6	10.03	10.73	10.56	9.60	9.81	9.71^{ab}	68.50	66.60	67.55	67.90^{abcd}	72.50^{cd}	70.40^{abc}	70.50	68.30	69.40^{bcde}
ICFH-13	9.63	9.00	9.36	9.69	10.29	10.04	9.96	9.58	9.77^{ab}	68.00	67.70	67.85	73.70^{fgh}	72.90^{cde}	73.50^{abc}	70.45	71.63	71.04^{def}
ICFH-14	9.17	8.89	8.49	9.91	10.69	10.26	9.93	9.69	9.81^{ab}	67.40	66.30	66.85	70.20^{cdef}	67.40^{ab}	77.90^{c}	67.40	71.47	69.43^{bcde}
ICFH-15	10.04	9.18	8.53	10.25	10.16	10.75	10.1	10.06	10.08^{b}	64.20	62.60	63.40	65.20^{a}	66.00^{ab}	67.60^{a}	65.10	65.13	65.11^{a}
ICFH-16	9.68	9.04	8.53	10.06	10.55	10.53	10.12	9.88	10.00^{ab}	65.30	64.00	64.65	67.80^{abcd}	64.40^{a}	76.10^{abc}	64.85	69.30	67.07^{abc}
ICFH-17	9.81	9.13	9.25	10.03	10.42	10.47	10.12	9.88	10.00^{ab}	65.50	64.40	64.95	67.80^{abcd}	67.00^{ab}	75.50^{abc}	66.25	69.23	67.74^{abc}
ICFH-18	9.81	9.06	9.37	9.99	10.42	10.09	10.12	9.71	9.91^{ab}	66.20	64.60	65.40	65.40^{a}	68.40^{abc}	69.00^{ab}	67.30	66.33	66.81^{ab}
ICFH-19	9.93	9.16	9.19	10.00	10.13	10.05	10.03	9.74	9.88^{ab}	66.30	65.90	66.10	70.20^{cdef}	66.60^{b}	76.60^{bc}	66.45	70.90	68.67^{bcd}
ICFH-20	9.34	8.89	9.18	9.65	10.42	9.84	9.88	9.46	9.67^{ab}	68.80	69.10	68.95	74.20^{ghi}	68.70^{abc}	70.70^{abc}	68.75	71.33	70.04^{cdef}
Mean	8.64	8.83		9.81	10.67	10.31	9.65	9.65		69.00	66.80	67.90	70.00	70.42	72.04	69.11	69.60	

a,b,c values bearing different superscript in column differs significantly(p=0.05)

ADF content increased with advancement of crop maturity from 33.24% at 1st cutting to 40.27 at 3rd cutting. The overall average ADF content of two cuttings varied between 35.11 to 39.57%. ADF content at 50 DAS was observed significantly highest with ICFH 1 (38.56%) and ICFH 7 (38.23%) with C1 cutting management. At 80 DAS ICFH 7 (39.84%) recorded the significantly maximum value for ADF. The cutting management, C_1 recorded significantly higher value of ADF (37.56%) as compared to C_2 (36.50%). ICFH-7 and ICFH-15 recorded the highest and lowest (35.50%) values of average ADF, respectively, however, the differences were not significant. The higher accumulation of carbohydrates and other structural material such as lignin and silica with maturity of the crop and reduction in leafiness, chlorophyll and crude protein could be the reason for increased ADF under saline environment with advancement of maturity stage. Single cut for green fodder followed by harvest for grain purpose has recorded higher ADF compared to the three cut for fodder purpose might be due to availability of longer time span for translocation and assimilation of carbohydrate in cell wall and its constituents. The difference in physiology and genetic mechanism of different accessions for conversion of sugar to cellulose as long chain polysaccharides, which essential for formation of fibre like structure may be reason for variation in ADF content. Our results are in close agreements with the findings of (Manjanagouda *et al.* 2015) [15].

Table 4: ADF content (%) of pearl millet fodder as influenced by different accessions and cutting management

Treatment VxC	**ADF (%)**								
	50 DAS			**80 DAS**	**110 DAS**		**Average**		
	C1	**C2**	**Mean**	**C2**	**C1**	**C2**	**C1**	**C2**	**Mean**
ICFH-1	38.56^{e}	35.62^{bcd}	37.09^{fg}	35.96^{ab}	40.50	36.13^{ab}	39.53	35.9	37.72
ICFH-2	36.15^{bcd}	35.69^{bcd}	35.92^{defg}	36.74^{abc}	40.26	36.39^{ab}	38.21	36.27	37.24
ICFH-3	33.50^{a}	35.69^{bcd}	34.60^{abcd}	36.73^{abc}	40.24	37.16^{ab}	36.87	36.53	36.7
ICFH-4	37.99^{de}	36.68^{d}	37.34^{g}	38.74^{cd}	41.10	37.91^{abc}	39.55	37.78	38.66
ICFH-5	37.44^{de}	33.50^{ab}	35.47^{cdef}	37.48^{abc}	40.43	36.95^{ab}	38.94	35.98	37.46
ICFH-6	33.45^{a}	35.18^{abcd}	34.32^{abcd}	36.15^{ab}	40.05	36.58^{ab}	36.75	35.97	36.36
ICFH-7	38.27^{de}	34.50^{abcd}	36.39^{efg}	39.84^{d}	40.87	38.10^{abc}	39.57	37.48	38.53
ICFH-8	37.43^{de}	36.08^{cd}	36.76^{fg}	38.06^{bcd}	40.72	37.78^{abc}	39.08	37.31	38.19
ICFH-9	36.50^{cde}	33.00^{a}	34.75^{abcde}	37.61^{abcd}	41.01	37.71^{abc}	38.76	36.11	37.43
ICFH-10	33.20^{a}	34.69^{abcd}	33.95^{abc}	35.95^{ab}	39.67	36.89^{ab}	36.44	35.84	36.14
ICFH-11	34.27^{abc}	35.73^{bcd}	35.00^{bcde}	37.67^{abcd}	40.31	38.04^{abc}	37.29	37.15	37.22
ICFH-12	34.43^{abc}	35.60^{bcd}	35.02^{bcde}	36.46^{abc}	40.26	36.59^{ab}	37.35	36.22	36.78
ICFH-13	34.37^{abc}	35.48^{bcd}	34.93^{abcde}	36.52^{abc}	40.25	37.17^{ab}	37.31	36.39	36.85
ICFH-14	34.10^{ab}	35.27^{abcd}	34.69^{abcde}	37.35^{abc}	40.50	40.27^{c}	37.30	37.63	37.47
ICFH-15	32.74^{a}	33.73^{abc}	33.24^{a}	35.58^{a}	39.03	36.01^{a}	35.89	35.11	35.5
ICFH-16	33.04^{a}	33.96^{abc}	33.50^{ab}	36.16^{ab}	38.38	38.49^{abc}	35.71	36.20	35.96
ICFH-17	33.05^{a}	34.80^{abcd}	33.93^{abc}	36.23^{ab}	39.66	38.11^{abc}	36.36	36.38	36.37
ICFH-18	33.21^{a}	34.86^{abcd}	34.04^{abc}	35.70^{ab}	40.16	36.38^{ab}	36.69	35.65	36.17
ICFH-19	33.27^{a}	35.26^{abcd}	34.27^{abcd}	37.28^{abc}	39.09	39.17^{bc}	36.18	37.24	36.71
ICFH-20	34.73^{abc}	36.58^{d}	35.66^{cdef}	37.68^{abcd}	40.25	36.66^{ab}	37.49	36.97	37.23
Mean	34.99	34.93		36.99	40.14	37.42	37.56^{a}	36.50^{b}	

a,b,c values bearing different superscript in column differs significantly(p=0.05)

Proximate quality components in grains of different accessions of pearl millet varied significantly when grown in saline environment (Table 5). ICFH -11 recorded the maximum dry matter (94.78%), whereas in ICFH -14 recorded lowest value (87.06%). ICFH-15 recorded maximum crude protein (10.43%); ether extract (4.56%) and ash content (3.68%) than other. ICFH-15 recorded lowest value of NDF (31.43%) and ADF (3.12%). The difference in dry matter content in grain may be due to genetic variability for uptake and accumulation of ions such as Na, K, Ca and Mg under saline environment. The difference in crude protein content in grain could be due to difference in genetic makeup. Physio-genetic variability might be reason for differential value of crude protein, ether extract, ash content and fibre fractionation (NDF and ADF content) in pearlmillet grains. The higher value of ether extract may be due to higher lipid and wax accumulation in grain vice-versa lower value. The higher amount of ash content in grain may be due to higher accumulation of soluble salt viz., Na, K, Ca and Mg in biomass and translocation in grain. The variable response in term of ADF and NDF content of grain could be due differential rate of conversion from simple sugar to cellulose, hemicellulose and lignin in cell wall and its constituents. Similar results of pearlmillet grain quality are reported by (Makarana *et al.* 2017^{b}) [13].

ICFH -15 proved significantly superior with the maximum calcium (193.63 mg/kg), magnesium (1208.13 mg/kg), iron (68.82 mg/kg), zinc (74.67 mg/kg), copper (9.19 mg/kg) and manganese (16.43 mg/kg) content in grains. The variable values for these nutrients content were observed under different accessions. The difference in accession for grain nutrients content may be attributed due to difference in their physio-genetic make up for uptake, translocation and assimilation of nutrients from soil to shoot and ultimately in grain. The accessions which have potential to counter act the higher concentration of soluble salt and maintain the optimum ionic balance could be the reason for higher value for these nutrients. Genetic variability for macro and micro nutrient content in a diverse range of pearl millet accession also reported by (Velu *et al.* 2008) [21] and (Kanatti *et al.* 2014) [7]

Table 5: Nutritional quality traits pearl millet grains as influenced bydifferent accessions

Treatment	DM (%)	CP (%)	EE (%)	ASH (%)	NDF (%)	ADF (%)	Ca(mg/kg)	Mg(mg/kg)	Fe(mg/kg)	Zn(mg/kg)	Cu(mg/kg)	Mn(mg/kg)
ICFH-1	88.08^{a}	9.50^{bcde}	4.31^{cde}	3.08^{ab}	33.28^{ab}	4.26^{abcd}	151.54^{abcd}	1131.00^{abc}	47.02^{a}	64.55^{abc}	6.53	12.95^{abcde}
ICFH-2	90.43^{abcd}	9.03^{bcde}	3.76^{abcde}	2.91^{ab}	34.31^{abc}	5.74^{cde}	151.18^{abcd}	1019.57^{a}	57.62^{abcd}	65.29^{abc}	6.66	13.16^{abcde}
ICFH-3	90.27^{abcd}	8.80^{bcde}	3.68^{abcd}	2.89^{ab}	34.32^{abc}	5.87_{de}	144.54^{abc}	1084.13^{abc}	53.85^{abc}	65.29^{abc}	6.56	12.86^{abcde}
ICFH-4	90.16^{abcd}	8.80^{bcde}	3.68^{abcd}	2.89^{ab}	34.32^{abc}	5.88^{de}	182.10^{bcd}	1053.18^{ab}	50.78^{ab}	62.49^{abc}	5.97	12.93^{abcde}
ICFH-5	89.19^{abcd}	9.91^{cde}	4.32^{cde}	3.20^{abc}	33.01^{ab}	4.07^{abc}	150.41^{abcd}	1119.53^{abc}	66.72^{d}	65.97^{abc}	7.13	15.12^{efgh}
ICFH-6	93.00^{de}	9.33^{bcde}	4.19^{cde}	2.98^{ab}	33.69^{abc}	5.45^{bcde}	143.27^{abc}	1138.56^{abc}	52.44^{abc}	71.48^{bc}	6.69	15.69^{fgh}
ICFH-7	92.45^{bcde}	9.16^{bcde}	3.80^{abcde}	2.92^{ab}	34.15^{abc}	5.65^{cde}	163.33^{abcd}	1183.03^{bc}	64.34^{cd}	69.32^{bc}	7.99	13.65^{abcdef}
ICFH-8	90.85^{abcd}	7.58^{ab}	3.28^{ab}	2.81^{ab}	35.04^{bc}	6.14^{e}	167.27^{abcd}	1105.97^{abc}	60.29^{bcd}	62.44^{abc}	5.68	12.57^{abcd}
ICFH-9	90.66^{abcd}	8.05^{abc}	3.50^{abc}	2.85^{ab}	34.94^{bc}	5.95^{de}	140.33^{abc}	1018.75^{a}	51.13^{ab}	64.55^{abc}	6.53	12.00^{ab}
ICFH-10	92.56^{cde}	8.40^{abcd}	3.50^{abc}	2.88^{ab}	34.61^{abc}	5.92^{de}	153.90^{abcd}	1067.69^{ab}	51.78^{abc}	58.79^{ab}	8.06	13.32^{abcde}
ICFH-11	94.78^{e}	7.94^{abc}	3.30^{ab}	2.83^{ab}	35.03^{bc}	6.11^{e}	179.87^{bcd}	1124.53^{abc}	51.65^{abc}	61.00^{abc}	8.71	14.65^{cdefgh}
ICFH-12	88.58^{ab}	6.59^{a}	2.98^{a}	2.71^{a}	36.57^{c}	6.45^{e}	122.67^{a}	1094.13^{abc}	50.94^{ab}	65.83^{abc}	8.01	12.58^{abcd}
ICFH-13	89.81^{abcd}	9.44^{bcde}	4.27^{cde}	3.08^{ab}	33.37^{abc}	4.34^{abcd}	134.78^{ab}	1102.13^{abc}	50.30^{ab}	65.97^{abc}	8.86	16.07^{gh}
ICFH-14	87.06^{a}	10.26^{de}	4.38^{de}	3.37^{bc}	31.99^{ab}	3.78^{ab}	153.20^{abcd}	1087.20^{abc}	51.56^{abc}	65.51^{abc}	8.77	14.91^{defgh}
ICFH-15	87.12^{a}	10.43^{e}	4.56^{e}	3.68^{c}	31.43^{a}	3.12^{a}	193.63^{d}	1208.13^{c}	68.82^{d}	74.67^{c}	9.19	16.43^{h}
ICFH-16	87.82^{a}	9.27^{bcde}	4.08^{bcde}	2.92^{ab}	34.11^{abc}	5.63^{cde}	180.68^{bcd}	1123.68^{abc}	57.83^{abcd}	53.33^{a}	8.17	11.29^{a}
ICFH-17	89.86^{abcd}	9.33^{bcde}	4.10^{bcde}	2.97^{ab}	33.85^{abc}	5.61^{cde}	185.78^{cd}	1183.03^{bc}	53.15^{abc}	70.00^{bc}	7.74	14.08^{bcdefg}
ICFH-18	89.15^{abcd}	9.38^{bcde}	4.22^{cde}	3.01^{ab}	33.38^{abc}	4.93^{bcde}	158.79^{abcd}	1104.99^{abc}	64.120^{cd}	63.88^{abc}	6.18	13.84^{bcdefg}
ICFH-19	89.09^{abc}	10.08^{de}	4.32^{cde}	3.22^{abc}	32.39^{ab}	3.81^{ab}	150.73^{abcd}	1086.70^{abc}	57.49^{abcd}	67.59^{bc}	6.55	12.72^{abcde}
ICFH-20	89.09^{abc}	9.62^{cde}	4.31^{cde}	3.11^{ab}	33.17^{ab}	4.26^{abcd}	148.00^{abcd}	1124.55^{abc}	52.16^{abc}	73.04^{c}	6.25	12.46^{abc}

a,b,c values bearing different superscript in column differs significantly($p=0.05$)

Conclusions

Our results suggest that ICFH-15 accession of pearlmillet and among cutting management strategy single cut for green fodder followed by harvest for grain purpose may be adapted as a choice for getting higher dry matter yield with better quality as compare to other accessions and cutting management strategy under saline environment in north-western region of India and elsewhere under similar agro-climatic conditions.

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