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Phenotypic variability of *Cenchrus ciliaris* L. germplasm in field gene bank

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Introduction

The world faces a continual need to increase forage crop productivity, and to develop new varieties more adapted to changing environmental and biological challenges, and evolving needs of Local communities. One of the main reasons for under-utilization of germplasm, according to curators, breeders and other users of plant genetic resources, is the lack of adequate passport, characterization and evaluation data (Biodiversity International, 2007). Buffel grass (*Cenchrus ciliaris* L.) is a C₄ perennial grass of arid lands distributed over hotter and drier parts of India, Mediterranean region and tropical and southern Africa. This forage grass is under the focus of different ecological issues like, response to desertification, quality of forage and impact of invasion. The use of genetic resources by the researchers, gene bank managers and farmers will be limited by non-availability of essential information of their phenotypic and genotypic characters. Therefore, the accurate documentation of information about the origin, characterization and performance of germplasm is essential for effective conservation, use and also for the Intellectual Property Rights (IPR) issues.

Materials and Methods

Seven accessions, viz. CAZRI-358, CAZRI-585, CAZRI-2178, CAZRI-2221, CAZRI-75, IGFRI-3108 and IGFRI-727 of *C. ciliaris* were grown during July 2014 at CAZRI, Jodhpur. The annual rainfall for the year was 366.6 mm which was received in 21 days. The accessions were grown in plot size of 3 m x 4 m in 3 replications with row to row spacing of 75 cm and sowing was continuous, thinning was done wherever required to give adequate space between plants (>10 cm). Fertilizers were applied at the rate of 40:20:0 kg/ha NPK respectively.

The different qualitative and growth attributes were recorded at different crop growth stages for the seven accessions. The quantitative attributes were recorded from 10 plants per accession and all plants evaluated were at the same physiological stage, planted only at one site and in one season to minimize differences due to environment of the characterization site (van de Wouw *et al.*, 1999). The crop was harvested around 140 days after sowing in single cut after seed collection.

Results and Discussion

The genetic variability of seven *C. ciliaris* genotypes was analyzed for different quantitative and qualitative traits. Among quantitative traits, more variability was recorded for flowering characters, like days to spike initiation and days to 50% flowering with the range of 33.0-46.3 and 42.7-69.3 respectively. In some genotypes, seeds of earlier emerged spikes started maturing before the emergence of spikes in other plants resulted in narrowed difference between days to 50% flowering and days to start of seed maturity. Likewise, significant variation was observed for the robustness characters like, leaf length, leaf width, flag leaf length and flag leaf (Table 1). Similarly genotypes showed significant variation for Seeds per spike and the range recorded 60.3-120.2. Most of the productive characters like, no. of tillers per plant, fertile tillers per plant, green fodder yield and dry matter yield data were found non-significant. A high correlation ($r > 0.7$) was found between plant height and leaf width; plant height and seed weight/plant, days to spike initiation and days to 50% flowering.

Among the genotypes, CAZRI-358 and CAZRI-585 had semi-erect plant habit whereas all other had erect plant habit. All the seven accessions had determinate growth habit. Nodal and intermodal pigmentation was light green in all seven genotypes. The initial vigour of plants varies from low to very high and CAZRI-2221 showed very high vigour which is the prime character for affecting fodder yield. The other qualitative character, i.e. waxiness of leaf and leaf sheath was found in genotypes CAZRI-75 and IGFRI-3108, which is important for drought tolerance in arid environment and the waxiness on internode was absent in all genotypes. The genotypes CAZRI-2178 and CAZRI-2221 showed pink fresh stigma color and all other genotypes were having white stigma. The genotype CAZRI-2178 had purple spikes color at

maturity which is different from all other genotype (Table 2). The grain shape and grain colour of all the genotypes was conical and brown respectively.

Table1. Parameters of variability in *Cenchrus ciliaris* genotypes

Characteristics	Mean \pm SE	Range	CV (%)	CD (5%)
Days to spike initiation	38.3 \pm 1.9	33.0-46.3	8.7	5.9
Days to 50% flowering	52.7 \pm 3.0	42.7-69.3	9.7	9.1
Plant height (cm)	64.4 \pm 4.0	48.2-75.8	10.7	12.3
Nodes on tiller	6.7 \pm 0.4	6.2-7.8	9.4	NS
Tillers/plant	17.7 \pm 1.8	15.1-19.2	17.9	NS
Branches/tiller	2.4 \pm 0.4	1.2-3.6	31.0	1.3
Inter-nodal Length (cm)	7.8 \pm 0.7	7.1-9.7	16.5	NS
Leaf length (cm)	29.3 \pm 1.2	22.1-36.7	6.8	3.6
Leaf width (mm)	7.2 \pm 0.3	5.7-8.8	8.0	1.0
Flag leaf length (cm)	19.4 \pm 1.1	12.9-23.6	9.4	3.3
Flag leaf width (mm)	6.2 \pm 0.3	4.6-8.1	9.0	1.0
Days to initiation of seed maturity	55.8 \pm 2.2	50.0-62.7	7.0	6.9
Fertile tillers/plant	11.5 \pm 2.8	8.0-16.8	41.9	NS
Peduncle length (cm)	23.4 \pm 1.3	15.7-31.4	9.2	3.9
Spike length (cm)	10.6 \pm 0.5	8.8-11.9	8.2	1.5
Seeds/spike	94.2 \pm 6.4	60.3-120.2	11.7	19.7
Seed weight/spike (g)	0.25 \pm 0.03	0.17-0.35	17.5	0.08
1000-seed weight (g)	2.71 \pm 0.14	1.82-3.93	8.8	0.42
Seed weight/plant (g)	4.3 \pm 1.9	2.0-8.7	76.8	NS
Green fodder yield/plant (g)	53.7 \pm 19.2	19.9-71.6	61.9	NS
Dry matter yield/plant (g)	27.5 \pm 8.7	12.3-33.5	54.6	NS

Table2. Qualitative characteristics observed visually in *Cenchrus ciliaris*

Characteristics	<i>Cenchrus ciliaris</i> Germplasm						
	CAZRI 358	CAZRI 585	CAZRI 2178	CAZRI 2221	CAZRI 75	IGFRI 3108	IGFRI 727
Growth habit	Semi-erect	Semi-erect	Erect	Erect	Erect	Erect	Erect
Initial vigour	High	Low	Medium	Very High	Medium	Low	Low
Stem thickness	Medium	Medium	Thin	Thin	Medium	Medium	Medium
Basal Internodal pigmentation	Purple	Purple	Light green	Purple	Light green	Light green	Light green
Leaf colour	Green	Green	Light green	Light green	Light green	Light green	Light green
Leaf waxiness	Absent	Absent	Absent	Absent	Present	Present	Absent
Leaf blade pubescence	Present	Sparse	Sparse	Present	Sparse	Sparse	Sparse
Waxiness on leaf sheath	Absent	Absent	Absent	Absent	Present	Present	Absent
Leaf sheath pubescence	Present	Present	Present	Sparse	Sparse	Present	Present
Leaf sheath colour	Green	Green	Light green	Light green	Light green	Light green	Light green
Fresh stigma colour	White	White	Pink	Pink	White	White	White
Spike colour at flowering	Green	Green	Light green	Light green	Light green	Light green	Light green
Spike colour at maturity	White	White	Purple	White	White	White	White

Conclusion

Significant variation was recorded among the genotypes of *C. ciliaris* for most of the growth attributes studied except, tiller production, fodder yield, seed yield, nodes on tillers and internodal length and high correlation was observed between plant height and leaf width; plant height and seed weight/plant, days to spike initiation and days to 50% flowering. Waxiness of leaf and leaf sheath was found in genotypes CAZRI-75 and IGFRI-3108, which is important character for drought tolerance in arid environment. The study will helps in choosing accessions with appropriate characteristics for further selection of suitable genotypes for drought resistance breeding.

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