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# ASSESSMENT OF MULTICUT FORAGE SORGHUM GENOTYPES FOR QUALITY BIOMASS PRODUCTION

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## SUMMARY

Sorghum is a versatile crop and is mainly used as fodder crop in North India. Due to high total soluble solids, crude protein percent and *invitr*o dry matter digestibility it is good for animal health and is preferred by animals over maize and pearl millet. Major breeding objective for any forage sorghum improvement program are high green biomass yield, good quality along with resistance against major insect pests and foliar diseases. Sorghum has ability for inherently high green biomass accumulation, high productivity per unit water utilization. Keeping above facts in view, we have evaluated ten hybrids and four advanced forage sorghum lines, along with four checks for fodder yield, quality and regeneration potential. The first cut of the crop was taken 64 days after sowing. Maximum green and dry fodder yield coupled with better quality was shown by hybrids SPH 1907 and SPH 1879, CSH24MF, CSV33MF and SSG 59-3. These hybrids can be used in future for high green and dry biomass production to fulfill the growing demand of fodder in the country.


**Key words :** Sorghum, green fodder, digestibility, quality

Sorghum (*Sorghum bicolor* L. Moench) is world's fifth most important crop with multiple uses. But sorghum is a fast growing crop which can be grown in arid and semi-arid tropics of the world with low input. It belongs to the family Poaceae and its some species are cultivated for grain purpose and some for animal pasture all over the world. Globally, sorghum is grown in 41.97 million hectares' area with 65.21 million tonnes of production and in India it is grown in 4.38 million ha area with 4.81 million metric tonnes of production and 1.10 metric tonnes/ha of productivity during 2020-21 (USDA, 2022). America stands first in total production with 9.4 million tonnes (15% of total production) followed by Ethiopia, Sudan. India ranks 5$^{th}$ in global sorghum production (USDA, 2020). In India it is mainly grown in Maharastra, Tamil Nadu, Karnataka, Gujrat etc. for human food and in North India for animal fodder. Forage sorghum is superior to fodder pearl millet in having lower oxalate and fibre content, high *in vitr*o dry matter digestibility and dry matter content, leafiness, high palatability, hardiness and suitability for silage making.

In addition to these its good quality, wide adaptability across environments and tolerance to biotic and abiotic stresses are the key traits which make it a better fodder as compared to maize and pearl millet. Good regeneration potential in forage sorghum is also a desirable trait which enhances its use as fodder crop, as it reduces overall inputs in terms of seed for sowing and labor for field preparation (Vinutha *et al.,* 2017). The contribution of sorghum as a fodder crop has increased the cost of production in recent years due to rapidly changing climatic conditions. It is preferred over maize due to its nutritional superiority and animal acceptability. Sorghum has enormous potential to accumulate high dry matter, sweetness and more crude proteins which affect its palatability and acceptability by milch cattle. Genus *Sorghum* has wide range of variability for morphological parameters like plant height, number of tillers per plant, leaf length, leaf breadth, stem diameter, regeneration potential and quality traits like crude protein, fiber, carbohydrates and *in vitro* dry matter digestibility (Aruna *et al.,* 2018). Estimation of hydrocyanic acid (HCN), an anti-nutritional factor is very important in any forage sorghum improvement program. The threshold limit of HCN in forage sorghum (on fresh weight basis) is 200 µg/g. Hydrocyanic acid is rapidly absorbed into the blood stream of grazing animals and can cause asphyxiation eventually leading to death of animal (Sher *et al.,* 2012). For any forage sorghum improvement programme high green biomass yield, high IVDMD%, better palatability, wide adaptability and stress resistance are major objectives and selection must be practiced focusing on these traits (Roy *et al.,* 2016). As far as nutritional composition of forage sorghum is concerned it contains 63-68% carbohydrates, 50-60% *in vitro* dry matter digestibility, 6-12 % crude proteins, 5-15% total soluble solids, 20-35% dry matter, 0.53% calcium and 0.24% phosphorus.

There is huge variability in sorghum for morphological and biochemical traits. So there is an ample scope for its improvement either using CMS system or wide hybridization. Green and dry fodder yield traits are dependent traits which are influenced by various independent traits like plant height, tillering ability, stem girth, no. of leaves, leaf length, leaf breadth etc. Hence, the present study was undertaken to evaluate forage sorghum genotypes for green and dry biomass yield, fodder quality and insect pest resistance which help the breeders in choosing the more appropriate varieties/hybrids for feeding livestock.

## MATERIALS AND METHODS

### Field experiment

A total of 18 forage sorghum lines were evaluated for green biomass yield, dry biomass yield, fodder quality and agronomic performance at Research Farm of Forage Section, CCS HAU, Hisar, India as given in Table 1. The crop was sown in RBD design with 3 replications in net plot size of 20.0 m$^2$ with crop geometry 25cm x 15cm on 30$^{th}$ April, 2019 and its I$^{st}$ cut was taken 64 days after sowing, II$^{nd}$ cut 48 days after I$^{st}$ cut and III$^{rd}$ cut 51 days after II$^{nd}$ cut. Recommended package of practices were followed for raising good crop. One irrigation was applied before I$^{st}$ cut and no subsequent irrigation was applied due to sufficient rainfall during the crop growth period.

**Observations recorded :** Morphological observations for early vigor (EV), plant height (PH), number of leaves/plant (NL), leaf length (LL), leaf breadth (LB), stem diameter (SD), number of tillers/ plant (NT), plant population (PP) and leaf stem (L/S) ratio were recorded before the I$^{st}$ cut. Green fodder yield (GFY) was recorded at the time of I$^{st}$, II$^{nd}$ and III$^{rd}$ cut. 500gm green fodder sample of each genotype was taken at the time of I$^{st}$, II$^{nd}$ and III$^{rd}$ cut then it was dried and dry fodder yield (DFY) was calculated using appropriate formula. Quality analysis was also done from the dried samples. At the time of each harvest, plants were cut about 10-15 cm above ground and regeneration potential (REG) was recorded after I$^{st}$ and II$^{nd}$ cut.

**Forage quality estimation :** Among quality parameters total soluble solids (TSS) % was measured using Refractometer. HCN content was estimated 30 days after sowing on the basis of green fodder sample using the method described by (Gilchrist *et al.,* 1967) and *invitro* dry matter digestibility (IVDMD) % and crude protein (CP) % were estimated from dried samples of I$^{st}$, II$^{nd}$ and III$^{rd}$ cut as methods described by Tilley and Terry (1963) and Micro-Kjeldhal's method, respectively.

**Data Analysis :** Data obtained was analyzed for ANOVA and correlation studies by using statistical package OP STAT. For analysis of ANOVA, yield data obtained in kg/plot was converted into q/ha. Skewness, kurtosis and graphs (for estimation of comparative performance of various genotypes in successive cuts) were estimated in MS-EXCEL.

## RESULTS AND DISCUSSION

Data was collected from 5 randomly choose plants and its mean was estimated which was used further analysis. The measure of central tendency *viz.* mean and range for different characters are presented in Table 1. Mean values of some important biomass and quality related traits was plotted as scatter graph shown in Fig. 1a, 1b, 1c and 1d.

**Mean performance :** Fifteen genotypes were evaluated for various morphological traits having plant population from 6.9-8.1 per meter row in net plot with early vigor of genotypes variing from 2.33 to 4, plant height ranged from 172.1 to 234.6 cm with maximum plant height in SPH 1905 (234.6 cm) followed by SPH 1935 (229.6 cm). Maximum number of tillers was 3.8 in SPH 1881 and range varied from 2.1 to 3.8. Number of leaves per plant varied from 21.22 (SPH 1935) to 33.8 (SPV 2669) with maximum leaf length 92.7 cm in SPH 1932 and minimum 73.3 in (SSG 59-3 local check) and leaf width varied from 4.4 (SPH 1881) to 7.9 cm (SPV 2669). Stem girth among these genotype varied from 1.29 to 1.83 cm. Regeneration ability being an important character in multicut forage sorghum its score varied from 2.7 (CSH24MF) to 5 (SPH 1881).

TSS in different genotypes ranged from 3.3 to 5.6 with mean 4.7 and concentration of hydrocyanic acid ranged from 54.4 to 187.1 with mean 123.6.

TABLE 1

Mean, range, skewness and kurtosis for various morphological traits in forage sorghum

| Traits | Mean | Range | Kurtosis | Skewness |
|---|---|---|---|---|
| GFY Ist Cut | 167.9 | 136.1-202.7 | -0.42 | 0.30 |
| GFY IInd Cut | 41.8 | 24.1-73.03 | 0.29 | 0.76 |
| GFY IIIrd Cut | 30.4 | 7.26-53.36 | 1.11 | -0.23 |
| DFY Ist Cut | 36.7 | 31.2-44.23 | -0.59 | 0.29 |
| DFY IInd Cut | 8.7 | 4.6-15.6 | 0.61 | 0.72 |
| DFY IIIrd Cut | 7.3 | 1.73-12.9 | 0.64 | 0.03 |
| PP | 7.5 | 6.9-8.1 | -0.86 | 0.20 |
| EV | 3.2 | 2.3-4.0 | -0.94 | 0.20 |
| PH | 208.9 | 172.1-234.6 | -0.08 | -0.47 |
| NT | 2.7 | 2.11-3.76 | 2.19 | 0.98 |
| NL | 27.3 | 21.2-33.9 | 0.02 | 0.36 |
| LL | 85.2 | 73.3-92.7 | 0.58 | -0.69 |
| LB | 5.97 | 4.35-7.9 | 0.19 | 0.13 |
| L/S/ratio | 0.28 | 0.22-0.32 | -0.45 | 0.09 |
| SG | 1.57 | 1.29-1.83 | -1.27 | -0.30 |
| REG | 3.85 | 2.66-5.00 | 0.39 | -0.63 |
| TSS | 4.66 | 3.33-5.56 | 0.82 | -0.84 |
| HCN | 123.6 | 54.4-187.5 | -0.57 | -0.15 |
| CP Ist cut | 8.4 | 6.93-9.07 | 0.00 | -0.71 |
| CP IInd cut | 7.8 | 6.66-8.59 | 0.42 | -0.42 |
| CP IIIrd cut | 7.8 | 7.32-8.30 | -0.54 | -0.28 |
| IVDMD Ist cut | 55.1 | 51.2-59.2 | -0.40 | 0.08 |
| IVDMD IInd cut | 52.1 | 48.4-56.4 | -0.23 | 0.08 |
| IVDMD IIIrd cut | 52.5 | 49.4-56.0 | -1.25 | 0.22 |

Crude protein content in I$^{st}$ cut ranged from 6.9 to 9.07 with mean 8.3, in II$^{nd}$ cut it ranged from 6.7 to 8.6 with mean 7.8 and in III$^{rd}$ cut ranged from 7.3 to 8.3 with mean value 7.8.

*In vitro* dry matter digestibility in I$^{st}$ cut ranged from 51.2 to 59.2 with mean 55.1, in II$^{nd}$ cut ranged from 48.4 to 56.4 with mean 52.1 and in III$^{rd}$ cut in different genotypes ranged from 49.4 to 56.0 with mean 52.5. From the above results it is clearly depicted that there is enormous variability in material under study. Thus data was further analyzed for correlation estimation.

**Correlation studies :** The phenotypic correlation coefficients were estimated between all the studied quantitative traits given in Table 2. GFY I$^{st}$ cut showed highly significant and positive phenotypic correlation with DFY I$^{st}$ cut (0.910**) and leaf length (0.797**). DFY I$^{st}$ cut showed positively significant phenotypic correlation with leaf length (0.703*). GFY II$^{nd}$ cut showed positive and significant phenotypic correlation with DFY II$^{nd}$ cut (0.995*), GFY III$^{rd}$ cut (0.639**), DFY III$^{rd}$ cut (0.670**) and regeneration score (0.722**). The negative phenotypic correlation with LB (-0.638**) and L/S ratio (-0.497*). DFY II$^{nd}$ cut showed positive highly significant phenotypic correlation with GFY III$^{rd}$ cut (0.654**), REG

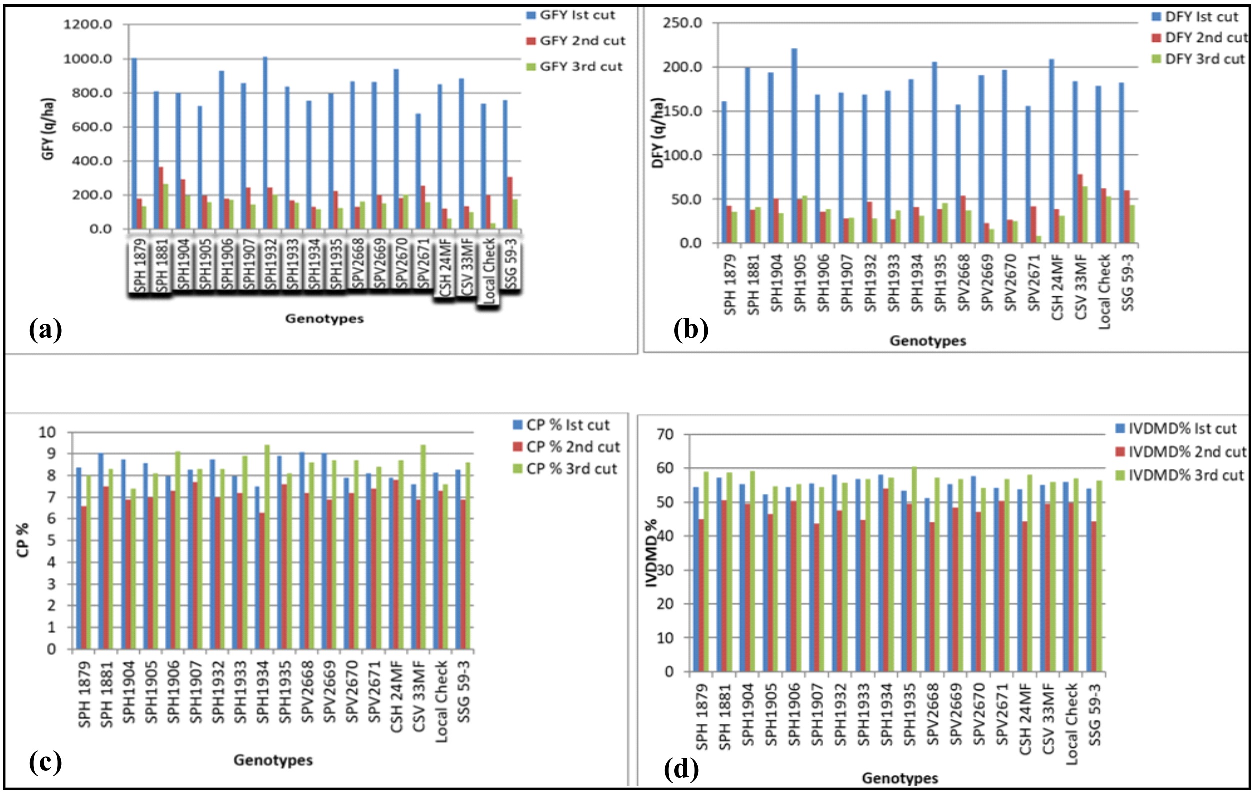


Fig. 1. Comparative performave of various genotypes for (a) GFY (q/ha) in various cuts (b) DFY (q/ha) in various cuts (c) CP% in various cuts and (d) IVDMD% in various cut.

(0.759**), DFY III$^{rd}$ Cut (0.679**) and negative phenotypic correlation with LB (-0.653**) and L/S ratio (-0.491*). GFY III$^{rd}$ cut showed significant positive phenotypic correlation with DFY III$^{rd}$ cut (0.981**) and REG (0.587*) and the rest of traits had no significant phenotypic correlation with other traits under study. DFY III$^{rd}$ cut showed significant positive phenotypic correlation with EV (0.474*) and REG (0.564*). PP showed positive and significant phenotypic correlation with NT (0.559*) and the rest of the traits showed no significance with other traits. PH showed significant negative phenotypic correlation with CP II$^{nd}$ cut (-0.483*). NT showed positive and significant phenotypic correlation with NL (0.661**). LB observed highly significant positive phenotypic correlation with L/S ratio (0.496**) and SG (0.76). It also showed negative significant phenotypic correlation with REG (-0.480**). SD showed highly significant negative phenotypic correlation with TSS (-0.472*). CP I$^{st}$ cut showed negative significant phenotypic correlation with IVDMD I$^{st}$ cut (-0.515*). TSS showed highly significant and positive phenotypic correlation with IVDMD II$^{nd}$ cut (0.504*).

The correlation coefficient is a measure to estimate the extent and direction of association among the studied characters. This knowledge about the correlation among the different traits make it possible to quantify how much a trait is influenced by other traits which is very essential to formulate a breeding programme based on indirect selection of various desirable traits aimed at achieving a desirable combination of various traits (Rigatti, 2018).

In the present investigation, genotypic and phenotypic correlation coefficients were calculated between twenty-four characters. The perusal of results of correlation analysis revealed that in most of the cases the genotypic correlation coefficient was higher than that of corresponding phenotypic correlation coefficient (Oliveira *et al.,* 2007). This indicated that the association between these traits was more due to the genetic factors shared between them. Therefore, in the present section, the emphases have been given on discussing phenotypic association between different traits, important from the point of view of major breeding objectives in forage sorghum.

From graphical presentation in Fig 1(a) of GFY I$^{st}$, II$^{nd}$ and III$^{rd}$ cut it is reported that SPH 1907 is best performing hybrid in I$^{st}$ cut followed by SPH 1879. But in II$^{nd}$ and III$^{rd}$ cut SPH 1881 and SPH 1904 showed higher green fodder yield as compared to other hybrids/genotypes. On the basis of DFY I$^{st}$ cut SPH 1905 is best hybrids followed by CSH24MF but in II$^{nd}$ and III$^{rd}$ cut maximum dry fodder yield was shown by CSV33MF, local check and SSG 59-3. As far as IVDMD% is concerned in I$^{st}$, II$^{nd}$ and III$^{rd}$ cut Maximum IVDMD% was reported in SPH 1932 followed by SPH 1934 and SPH 1881. In II$^{nd}$ cut IVDMD% decreases in all genotypes and it again increases in III$^{rd}$ cut and was maximum in SPH 1935 followed by SPH 1904, SPH 1881 and SPH 1819 in III$^{rd}$ cut.

Crude protein is major quality trait for any forage crop. Concentration of protein in any fodder crop affects the microflora in animal rumen and digestibility of fodder inturn. Among all genotypes maximum crude protein was reported by SPH 1881 followed by SPH 1935 in I$^{st}$ cut. Among II$^{nd}$ cut maximum crude protein was reported in CSH24MF followed by SPH 1907. In III$^{rd}$ cut it was maximum in SPH 1934 followed by CSV33MF and SPH 1906. In this experiment, GFY I$^{st}$ cut was found positively associated with DFY I$^{st}$ cut and LL at significance level ($p<0.01$). DFY I$^{st}$ cut showed positively phenotypic correlated with LL. GFY II$^{nd}$ cut showed positive significant correlation with DFY II$^{nd}$ cut, GFY III$^{rd}$ cut, DFY III$^{rd}$ cut and regeneration potential (Yadav *et al.,* 2005; Kumari *et al.,* 2016).

A significant and negative correlation with LB and L/S ratio at significance (>0.01) was also reported. DFY II$^{nd}$ cut showed positive phenotypic correlation with GFY III$^{rd}$ cut, DFY III$^{rd}$ cut and regeneration potential at significant level (< 0.01). The negative and significant correlation with LB and L/S ratio. GFY III$^{rd}$ cut showed positive significant correlation with DFY III$^{rd}$ cut (Thant *et al.,* 2021) and regeneration potential at significantly level (<0.01). DFY III$^{rd}$ cut showed significant positive correlation with EV and regeneration potential. PH showed significant negative phenotypic correlation with NT, CP II$^{nd}$ cut at significant level (>0.01). NT was found significant positive correlation with NL at significance level (<0.01). LB was shown highly significant positive phenotypic correlation with L/S ratio and SD (<0.01). SD was highly significant negative phenotypic correlation with TSS (>0.01). CP I$^{st}$ cut showed negative significant correlation with IVDMD I$^{st}$ cut. TSS was found highly positive phenotypic correlation with IVDMD II$^{nd}$ cut at significance level (<0.01). The results from the present study are in agreement with the reports by Prakash *et al.,* 2010, Singh *et al.,* 2016; Chakraborthy *et al.,* 2020. Slight contradictions between the previous studies and the present one might

TABLE 2
Phenotypic correlation study among forage sorghum genotypes for various morphological and quality traits

| | GFY I$^{st}$ cut | DFY I$^{st}$ cut | GFY II$^{nd}$ cut | DFY II$^{nd}$ cut | GFY III$^{rd}$ cut | DFY III$^{rd}$ cut | PP | EV | PH | NT | NL | LL | LB | L/S ratio | SD | REG | TSS | CP I$^{st}$ cut | IVDMD I$^{st}$ cut | HCN | CP II$^{nd}$ cut | IVDMD II$^{nd}$ cut | CP III$^{rd}$ cut | IVDMD III$^{rd}$ cut |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GFY I$^{st}$ Cut | 1 | | | | | | | | | | | | | | | | | | | | | | | |
| DFY I$^{st}$ Cut | **0.910**** | 1 | | | | | | | | | | | | | | | | | | | | | | |
| GFY II$^{nd}$ Cut | -0.232$^{NS}$ | -0.033$^{NS}$ | 1 | | | | | | | | | | | | | | | | | | | | | |
| DFY II$^{nd}$ Cut | -0.241$^{NS}$ | -0.060$^{NS}$ | **0.995**** | 1 | | | | | | | | | | | | | | | | | | | | |
| GFY III$^{rd}$ Cut | 0.206$^{NS}$ | 0.297$^{NS}$ | **0.639**** | **0.654**** | 1 | | | | | | | | | | | | | | | | | | | |
| DFY III$^{rd}$ Cut | 0.205$^{NS}$ | 0.313$^{NS}$ | **0.670**** | **0.679**** | **0.981**** | 1 | | | | | | | | | | | | | | | | | | |
| PP | 0.263$^{NS}$ | 0.367$^{NS}$ | 0.284$^{NS}$ | 0.266$^{NS}$ | 0.316$^{NS}$ | 0.347$^{NS}$ | 1 | | | | | | | | | | | | | | | | | |
| EV | 0.233$^{NS}$ | 0.338$^{NS}$ | 0.393$^{NS}$ | 0.379$^{NS}$ | 0.428$^{NS}$ | **0.474*** | 0.178$^{NS}$ | 1 | | | | | | | | | | | | | | | | |
| PH | -0.460$^{NS}$ | -0.284$^{NS}$ | 0.063$^{NS}$ | 0.052$^{NS}$ | -0.167$^{NS}$ | -0.151$^{NS}$ | -0.437$^{NS}$ | 0.064$^{NS}$ | 1 | | | | | | | | | | | | | | | |
| NT | -0.134$^{NS}$ | 0.025$^{NS}$ | 0.462$^{NS}$ | 0.466$^{NS}$ | 0.389$^{NS}$ | 0.441$^{NS}$ | **0.559*** | 0.303$^{NS}$ | -0.437$^{NS}$ | 1 | | | | | | | | | | | | | | |
| NL | -0.253$^{NS}$ | -0.132$^{NS}$ | 0.459$^{NS}$ | 0.461$^{NS}$ | 0.329$^{NS}$ | 0.312$^{NS}$ | **0.547*** | 0.251$^{NS}$ | -0.222$^{NS}$ | **0.661**** | 1 | | | | | | | | | | | | | |
| LL | **0.797**** | **0.703**** | -0.250$^{NS}$ | -0.255$^{NS}$ | 0.444$^{NS}$ | 0.410$^{NS}$ | 0.247$^{NS}$ | 0.322$^{NS}$ | -0.323$^{NS}$ | -0.114$^{NS}$ | -0.124$^{NS}$ | 1 | | | | | | | | | | | | |
| LB | 0.225$^{NS}$ | 0.101$^{NS}$ | **-0.638**** | **-0.653**** | -0.358$^{NS}$ | -0.457$^{NS}$ | 0.118$^{NS}$ | -0.149$^{NS}$ | -0.128$^{NS}$ | -0.373$^{NS}$ | 0.040$^{NS}$ | 0.379$^{NS}$ | 1 | | | | | | | | | | | |
| L/S ratio | 0.467$^{NS}$ | 0.298$^{NS}$ | **-0.497*** | **-0.491*** | -0.199$^{NS}$ | -0.231$^{NS}$ | 0.035$^{NS}$ | 0.213$^{NS}$ | -0.334$^{NS}$ | -0.167$^{NS}$ | 0.027$^{NS}$ | 0.383$^{NS}$ | **0.496*** | 1 | | | | | | | | | | |
| SD | 0.088$^{NS}$ | 0.101$^{NS}$ | -0.413$^{NS}$ | -0.430$^{NS}$ | -0.268$^{NS}$ | -0.355$^{NS}$ | 0.038$^{NS}$ | -0.225$^{NS}$ | 0.076$^{NS}$ | -0.427$^{NS}$ | -0.042$^{NS}$ | 0.221$^{NS}$ | **0.762**** | 0.105$^{NS}$ | 1 | | | | | | | | | |
| REG | -0.331$^{NS}$ | -0.259$^{NS}$ | **0.722**** | 0.759** | **0.587*** | **0.564*** | 0.042$^{NS}$ | 0.291$^{NS}$ | 0.240$^{NS}$ | 0.282$^{NS}$ | 0.345$^{NS}$ | -0.234$^{NS}$ | **-0.480*** | -0.416$^{NS}$ | **-0.472*** | 1 | | | | | | | | |
| TSS | -0.099$^{NS}$ | 0.066$^{NS}$ | 0.087$^{NS}$ | 0.078$^{NS}$ | 0.096$^{NS}$ | 0.085$^{NS}$ | -0.050$^{NS}$ | 0.109$^{NS}$ | 0.430$^{NS}$ | -0.020$^{NS}$ | 0.079$^{NS}$ | -0.029$^{NS}$ | -0.044$^{NS}$ | -0.039$^{NS}$ | -0.050$^{NS}$ | 0.324$^{NS}$ | 1 | | | | | | | |
| CP I$^{st}$ cut | 0.366$^{NS}$ | 0.371$^{NS}$ | -0.163$^{NS}$ | -0.159$^{NS}$ | -0.076$^{NS}$ | -0.098$^{NS}$ | 0.036$^{NS}$ | -0.132$^{NS}$ | -0.239$^{NS}$ | 0.065$^{NS}$ | -0.215$^{NS}$ | 0.209$^{NS}$ | 0.057$^{NS}$ | -0.053$^{NS}$ | -0.003$^{NS}$ | -0.121$^{NS}$ | -0.135$^{NS}$ | 1 | | | | | | |
| IVDMD I$^{st}$ cut | -0.066$^{NS}$ | -0.034$^{NS}$ | 0.050$^{NS}$ | 0.053$^{NS}$ | 0.214$^{NS}$ | 0.288$^{NS}$ | 0.386$^{NS}$ | 0.204$^{NS}$ | 0.138$^{NS}$ | 0.111$^{NS}$ | 0.187$^{NS}$ | 0.122$^{NS}$ | -0.038$^{NS}$ | -0.071$^{NS}$ | 0.075$^{NS}$ | 0.093$^{NS}$ | 0.224$^{NS}$ | **-0.515*** | 1 | | | | | |
| HCN | 0.329$^{NS}$ | 0.199$^{NS}$ | -0.020$^{NS}$ | -0.054$^{NS}$ | 0.076$^{NS}$ | 0.072$^{NS}$ | 0.249$^{NS}$ | -0.110$^{NS}$ | -0.300$^{NS}$ | -0.051$^{NS}$ | -0.029$^{NS}$ | 0.395$^{NS}$ | 0.214$^{NS}$ | -0.073$^{NS}$ | -0.089$^{NS}$ | -0.090$^{NS}$ | -0.134$^{NS}$ | 0.164$^{NS}$ | -0.249$^{NS}$ | 1 | | | | |
| CP II$^{nd}$ cut | 0.261$^{NS}$ | 0.066$^{NS}$ | -0.410$^{NS}$ | -0.401$^{NS}$ | -0.183$^{NS}$ | -0.215$^{NS}$ | -0.063$^{NS}$ | -0.054$^{NS}$ | **-0.483*** | 0.197$^{NS}$ | 0.153$^{NS}$ | 0.243$^{NS}$ | 0.292$^{NS}$ | 0.296$^{NS}$ | -0.122$^{NS}$ | -0.220$^{NS}$ | -0.286$^{NS}$ | 0.309$^{NS}$ | -0.380$^{NS}$ | 0.441$^{NS}$ | 1 | | | |
| IVDMD II$^{nd}$ cut | 0.121$^{NS}$ | 0.084$^{NS}$ | 0.040$^{NS}$ | 0.053$^{NS}$ | 0.060$^{NS}$ | -0.008$^{NS}$ | -0.129$^{NS}$ | -0.096$^{NS}$ | 0.068$^{NS}$ | -0.328$^{NS}$ | 0.066$^{NS}$ | 0.153$^{NS}$ | 0.180$^{NS}$ | 0.103$^{NS}$ | 0.309$^{NS}$ | 0.098$^{NS}$ | **0.504*** | 0.139$^{NS}$ | -0.071$^{NS}$ | 0.025$^{NS}$ | -0.171$^{NS}$ | 1 | | |
| CP III$^{rd}$ cut | -0.053$^{NS}$ | -0.076$^{NS}$ | 0.198$^{NS}$ | 0.203$^{NS}$ | 0.237$^{NS}$ | 0.224$^{NS}$ | 0.078$^{NS}$ | 0.108$^{NS}$ | -0.295$^{NS}$ | 0.427$^{NS}$ | -0.029$^{NS}$ | -0.082$^{NS}$ | -0.303$^{NS}$ | -0.169$^{NS}$ | -0.450$^{NS}$ | 0.409$^{NS}$ | 0.191$^{NS}$ | 0.093$^{NS}$ | -0.116$^{NS}$ | 0.133$^{NS}$ | 0.196$^{NS}$ | -0.185$^{NS}$ | 1 | |
| IVDMD III$^{rd}$ cut | 0.211$^{NS}$ | 0.147$^{NS}$ | 0.117$^{NS}$ | 0.140$^{NS}$ | 0.092$^{NS}$ | 0.047$^{NS}$ | 0.331$^{NS}$ | -0.287$^{NS}$ | -0.183$^{NS}$ | -0.157$^{NS}$ | 0.228$^{NS}$ | 0.088$^{NS}$ | 0.272$^{NS}$ | -0.096$^{NS}$ | 0.425$^{NS}$ | 0.145$^{NS}$ | -0.051$^{NS}$ | 0.081$^{NS}$ | 0.049$^{NS}$ | 0.190$^{NS}$ | -0.052$^{NS}$ | 0.455$^{NS}$ | -0.221$^{NS}$ | 1 |

be due to the difference of the study material used, methods and environmental conditions.

## CONCLUSION

Thus on the basis of this study we have identified some promising hybrids having high green and dry biomass production potential with multicut nature, good regeneration potential and better quality in successive cuts. So, the hybrids SPH 1907, SPH 1879, CSH24MF, CSV33MF and SSG 59-3 will certainly help in future to fulfill growing fodder demand of the country.

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