Evaluation for Genetic variability, Correlation and Path Coefficient in Mutant Population of Forage Sorghum *(Sorghum bicolor L. Moench)*

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By

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CERTIFICATE

This is to certified that this synopsis entitled "**Evaluation for Genetic variability, Correlation and Path Coefficient in Mutant Population of Forage Sorghum** *(Sorghum bicolor L. Moench)*" submitted in partial fulfilment of requirements for degree – **Master of Science in Genetics and Plant Breeding** by **Pranay Reddy**, Registration no. **11700082** to **Department of Genetics and Plant Breeding, School of Agriculture, Lovely Professional University**, has been formulated and finalized by the student himself on the subject.

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DECLARATION

I hereby declare that the project work entitled **—** “**Evaluation for Genetic variability, Correlation and Path Coefficient in Mutant Population of Forage Sorghum** *(Sorghum bicolor L. Moench)***”** is an authentic record of my work carried at **Lovely Professional University** as requirements of Project work for the award of degree -**Master of Science in Genetics and Plant Breeding**, under the guidance of **Dr. Nidhi Dubey, Assistant Professor, School of Agriculture, Lovely Professional University, Phagwara, Punjab**

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Index

1. Introduction

Sorghum is a diploid, 2n = 20, perennial (usually cultivated as an annual), sexually reproducing species. It is mainly a self-pollinated crop, however, some of the grassy sorghums such as sudan grass have been reported to have as much as 34% natural cross-pollination. It is believed that sorghum originated some 5000 to 7000 years ago in eastern Africa (Jain S.K. *et al.,* 2016).

Sorghum is an important crop widely grown for grain and fodder yield with a greater emphasis on fodder particularly in semi arid tracts. Forage sorghum has become very popular among the farmers due to its wide adaption, rapid growth, higher green and dry fodder, ratoonability and tolerance to drought stress. Because, sorghum fodder plays an important role in the health and nutrition of the large population of livestock in the country like India which is having 20 per cent livestock population of the world (Hand Book of Agriculture, 2006).

Forage sorghum is considered to be the most heat and drought resistant summer forage with a fairly high green forage yield. The total area under forages in 2012 in Punjab was 1.82 million hectares with green forage production of 38.8 million tons. The land area of Punjab under forage sorghum in 2012 was 0.588 million hectares with production of 7.984 million tons. The average production of forage sorghum (13 t ha) in Punjab 1 province of India is much less as compared to potential of 50-70 t ha. Seed with low yield potential, 1 suboptimal plant population, drought, weeds infestation, suboptimal and unbalanced use of fertilizers, insect pest attack and marketing problems are major constraints in forage sorghum production in Punjab. The paper is drawn from a larger study on "Economics of Production, Processing and Marketing of Fodder Crops in Punjab" sponsored by the Ministry of Agriculture, Government of India (Grover *et al*., 2011).

Sorghum is grown for green forage varieties with sweet, juicy stems (sweet sorghum) are used to produce syrup. Sorghum grain is used to make bread, biscuits, starch, sugar, syrups, and alcohol beer and malt products. The stalks are used as fuel, fencing and roofing material. Sweet sorghum has many good characteristics such as a drought resistance, water lodging tolerance, salinity resistance and with a high yield of biomass.

Many of the forage sorghums have a 'sweet stalk' making them more palatable to livestock when utilized for grazing or for hay. The stalks of forage sorghum tend to be large and succulent, making them less palatable for grazing and sometimes slow in drying down for hay production. Their regrowth potential is not as good as the other types of sorghums making them more suitable for a one time hay cutting or for silage production. The forage sorghums are capable of producing very high amounts of dry matter per acre.

In India there is a marked seasonality in forage production, which makes production systems mostly dependent on the planning for use of conserved forage or forage with high drought tolerance. Sorghum has the potential to be used as ruminant feed, especially in semi-arid regions, for being resistant to drought and high temperatures, and shows high yield and high nutritional value. In ruminant nutrition, sorghum can be used for producing hay, silage and for cutting and/or grazing.

To overcome situation, genetically stable genotypes having high fodder yield potential are urgently needed. It is therefore, necessary to estimate relative amounts of genetic and non-genetic variability exhibited by different characters using suitable parameters like genetic coefficient of variability (GCV), heritability (H) and genetic gain (GG). Besides estimating the nature and magnitude of correlation coefficient, path coefficient analysis and genetic association between green fodder yield and yield traits, the traits that contributed to green fodder yield and are suitable to identified by variability, correlation and path coefficient analysis between green fodder yield and its attributes. Correlation measure the level of dependence traits and out of numerous correlation coefficients it is often difficult to determined the actual mutual effects among traits (Ikanovic et al., 2011).

Keeping in view the aforesaid problems, the present investigation has been planned with the following objectives:

Objectives

1. To estimate the extent of variability for fodder yield, HCN content and WUE.
2. To estimate the extent of phenotypic and genotypic correlation between the fodder yield.
3. To estimate direct and indirect effects using path analysis.
4. To study the genetic diversity analysis among the forage crop.

2. Review of literature

The success of any plant improvement programme mainly depends on the right selection of the material and its skillful management. It is only possible when we possess knowledge of previous work done in concerned field. In fodder sorghum substantial contribution has been made to the literature regarding its Genetics and Breeding in the recent years. The literature related to the various aspects of the parent study has been reviewed under the following heads;

- **2.1)** Genetic variability
- **2.2)** Correlation and path analysis
- **2.3)** Genetic diversity

2.1) Genetic variability

Kour et al., (2016) reported high magnitude of genetic coefficient of variation (GCV), phenotypic coefficient of variation (PCV), heritability and genetic advance as percentage of mean for leaf: stem ratio, number of leaves plant^{-1}, green fodder yield plant^{-1}, stem girth and dry matter yield plant^{-1} which indicated presence of sufficient variability among genotypes taken under study.

Rana et al., (2016) reported Genetic variability, correlation and path analysis was studied for yield and its attributing characters. A wide range of phenotypic variability was recorded for green fodder yield per plant and its component traits. In the present study magnitude of genetic coefficient of variation (GCV), phenotypic coefficient of variation (PCV), heritability and genetic advance as percentage of mean were recorded high for various characters like leaf: stem ratio, number of leaves per plant, green fodder yield per plant, stem girth and dry matter yield per plant. Green forage yield per plant was highly significant and positively correlated with stem girth, leaf length, leaf width and dry matter yield per plant at both genotypic and phenotypic level. These traits had high magnitude of genotypic correlation with green forage yield per plant.

Sultan Singh *et al.* (2003) were evaluated eleven brown midrib and nine white midrib genotypes with respect to crude protion, fibre composition, insacco drymatter, organic matter, cell wall components. Nonsignificant differences were observed in dry matter, crude protein and organic matter contents between brown midrib and white midrib genotypes phenolic contents were significantly lower in brown midrib (0.2) than white midrib (0.3) Sorghum.

2.2) Correlation and path analysis

Jain et al., (2010) reported that Plant height, stem girth and leaf length were positively and significantly associated with green fodder and dry fodder yield per plant. Leaf breath was positively and significantly associated with plant height, number of leaves per plant and leaf length. Green fodder yield per plant had positive and significant correlation as well as high direct effect via dry fodder yield per plant, plant height, number of leaves per plant and stem girth.

Yadav *et al.* (2003) studied the correlation of fodder yield and its components in 106 forage sorghum genotypes. Plant height showed significant positive correlation with leaf length, number of leaves/plant, growth rate, green fodder yield and dry fodder yield. Dry matter/plant and negative correlation with leaf : stem ratio, shoot fly attack and Brix-percentage.

Pooranchand et al., (2000) studied the correlation among the yield and yield components of 16 Sorghum genotypes. The green fodder yield at 50% flowering was significantly and positively associated with days to flowering, number of leaves, leaf stem ratio and plant height. Days to flowering had significant and positive associations with the number of leaves, plant height and stem girth. The number of leaves was positively correlated with plant height and stem girth. The leaf stem ratio was positively correlated with plant height but was negatively associated with stem girth.

2.3) Genetic diversity

Jain et al., (2016) reported genotypes were divided into four clusters, Cluster-I contained 3 genotypes, cluster-II contained 9 genotypes, cluster-III contained 14 genotypes and cluster-IV contained 2 genotypes clusters showed the presence of considerable genetic diversity among the genotypes for fodder yield and their contributing traits i.e. green fodder yield, dry fodder yield, stem girth, leaf width, number of leaves/plant, leaf length, and days to 50% flowering had most variation and Analysis revealed that cluster first and second were superior in terms of green and dry fodder yield, third cluster for early maturity and forth for brix per cent.

Singh, *et al.* (2008) were evaluated 32 genotypes of forage sorghum (*S.bicolor*) for genetic diversity and found that the leaves per plant (45.16) had the greatest contribution towards genetic divergence followed by green fodder yield per day (19.76), internode length (14.31) and leaf breadth (13.31).

Rajesh *et al.*, (2002) revealed that number of leaves per plant, leaf area per plant, number of tillers per plant, leaf stem ratio and regeneration potential are desirable for multicut breeding programmes. The maximum inter cluster distance was observed between clusters III and X followed by clusters VI and X. however no correspondence was observed between the geographical and genetic diversity.

3. Material and Method

Plant material

The present field experiment on forage sorghum (*Sorghum bicolor (L.) Moench*) was conducted during *kharif*-2018 at experimental fields of breeding department, school of Agriculture, LPU, phagwara, (punjab). The experimental material comprised of 15-20 mutants obtained through mutation breeding (M1 generation) by the use of gamma rays.

Experimental detail

Crop	:	Fodder sorghum
Design	:	RBD (Randomize block design)
Genotypes	:	15-20
Experimental year	:	2018-19
No. of replications	:	3
Spacing	:	30 x15 cm
Season	:	*Kharif*
Mutation treatment	:	Gamma ray (400 Gy)

Observations to be recorded:

A	**Quantitative traits**	**7**	Seed size
1	4th leaf length (cm)	**8**	Awns
2	4th leaf width (cm)	**C**	**Quality traits**
3	No. of leaves/stem	**1**	Dry matter (%)
4	Leaf stem ratio	**2**	Dry matter yield (t/ha/yr)
5	Plant height (cm)	**3**	Crude protein (%)
6	No. of tillers /plant	**4**	Crude protein yield (t/ha/yr)
7	Stem girth (cm)	**5**	Crude fibre (%)*
8	Days to 50% flowering	**6**	Crude fat (%)*
9	Length of panicle (cm)	**7**	HCN (ppm)
10	No of spikelets per panicle	**8**	Nitrogen (%)
11	1000 seed weight (g)	**9**	Phosphorus (%)
B	**Qualitative traits**	**10**	Potassium (%)
1	Leaf colour	**11**	Total soluble sugar (TSS)
2	Ligule	**12**	Water use efficiency (WUE)
3	Leaf midrib colour	**13**	Acid detergent fibre
4	Waxy bloom	**14**	Neutral detergent fibre
5	Inflorescence compactness	**15**	Inorganic minerals
6	Seed colour	**16**	Proline content

Statistical analysis

1) Estimation of variability (Panse and Sukhatme, 1961)
2) Heritability and Genetic advance (Hanson et al., 1956 and Johnson et al., 1955)
3) Correlation coefficient analysis (Miller et al., 1958)
4) Path coefficient analysis (Dewey and Lu, 1959)
5) Analysis of genetic diversity (Mahalanobis, 1928)

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