International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
www.chemijournal.com
IJCS 2021; 9(1): 703-705
© 2021 IJCS
Received: 08-11-2020
Accepted: 18-12-2020

Mayank Chaudhary
Department of Genetics and Plant Breeding, Sardar Vallabhbhai Patel University of Agriculture and Technology, Meerut, Uttar Pradesh, India

SK Singh
Department of Genetics and Plant Breeding, Sardar Vallabhbhai Patel University of Agriculture and Technology, Meerut, Uttar Pradesh, India

Mukesh Kumar
Department of Genetics and Plant Breeding, Sardar Vallabhbhai Patel University of Agriculture and Technology, Meerut, Uttar Pradesh, India

Pooran Chand
Department of Genetics and Plant Breeding, Sardar Vallabhbhai Patel University of Agriculture and Technology, Meerut, Uttar Pradesh, India

Mukesh Kumar
Department of Agricultural Biotechnology, Sardar Vallabhbhai Patel University of Agriculture and Technology, Meerut, Uttar Pradesh, India

Corresponding Author:
Mayank Chaudhary
Department of Genetics and Plant Breeding, Sardar Vallabhbhai Patel University of Agriculture and Technology, Meerut, Uttar Pradesh, India

Study of genetic variability in relation to yield and yield components in forage sorghum (*Sorghum bicolor* L. Moench)

Mayank Chaudhary, SK Singh, Mukesh Kumar, Pooran Chand and Mukesh Kumar

DOI: https://doi.org/10.22271/chemi.2021.v9.i1j.11308

Abstract
The present investigation was carried out the genetic analysis of breeding material through components of variance, nature and magnitude of gene effects, genetic variability, heritability, genetic advance, correlation coefficients, general and specific combining ability effects and heterosis among yield and it components in parents and F_1's hybrids. Ten diverse parents *i.e.*, UP Chari-1, HC-308, UP Chari-2, HC-171, Pant Chari-8, CSV-17, Pant Chari-6, CSV-84, Pant Chari-5 and Rajasthan Chari-1, germplasm selected from SVPUA&T, Meerut, U.P. Ten parents diallel set excluding reciprocals was made during the season of *kharif* 2018 by raising the crop at Crop Research Centre of Sardar Vallabhbhai Patel University of Agriculture & Technology, Meerut. All the 45 crosses and their ten parents were grown during *kharif* season 2019. All the 45 F_1's hybrids along with ten parents were sown in randomized block design with three replications. Observations were recorded on days to 50% flowering, plant height, leaf breadth, leaf length, stem girth, leaves per plant, leaf area, leaf stem ratio, total soluble solids and green fodder yield. Analysis of variance for parents and crosses showed highly differed significantly for all the characters. Parents vs crosses exhibited highly significant for the attributes namely, days to 50% flowering, plant height, leaf breadth, leaf length, leaf area and green fodder yield, which indicated that wide genotypic differences among the parental lines and F_1's hybrids. High heritability coupled with high genetic advance as percent of mean was observed for the traits *viz.*, plant height, and leaves per plant, leaf area, stem girth, leaf stem ratio and green fodder yield, suggesting that the genes governing these characters may have additive effect.

Keywords: Sorghum bicolor, variability, heritability, genetic advance

Introduction

Fodder and feed are the major inputs in animal production especially in *milch* animal, which account for about 60 to 70% of total cost of milk production. Green fodder availability is 400.60 million tones against the requirement of 1,097 million tones, which shows 63.50 per cent deficit under different agro ecological zones in India. Sorghum [*Sorghum bicolor* (L.) Moench] is the fifth most important crop in the world. It is a member of Poaceae family with chromosome number 2n=2x=20. Its centre of origin is Ethiopia (Africa). It is an often cross pollinated crop, having average six percent natural cross pollination (Vekariya *et. al*., 2017) [16]. Sorghum's ability to withstand drought and heat stresses and to give reasonable yields under adverse environmental conditions have raised its importance as a food security and bioenergy crop in arid and semi-arid tropics. In stress environments, pearl millet and sorghum are the dominant crops and receive fewer agricultural inputs than any other major cereals. Sweet sorghum (*Sorghum bicolor*) is a natural variant of common grain sorghum with high stem sugar content, which can offer both food and fuel. The sugar content in the stalk juice of sweet sorghum reaches 10 to 25% at grain maturity. This sugar in the juice can be used to produce sugar, syrup, wine or biofuel. The bagasse is used as forage or as raw material for the paper industry. Sweet sorghum ensures food and feed security and provides opportunities for additional income for small farmers serving as a feedstock for bioethanol production while protecting the environment. It requires 37% less nitrogen fertilizer and 17% less irrigation water than maize, and could yield more ethanol than maize during a dry year.

It's potential ethanol yield of 5000 L//ha/yr. is more than that of sugarcane, maize, cassava and wood (Endalamaw *et. al*., 2017) [6].

Materials and Methods

During 2018, ten genotypes of forage sorghum *i.e.*, UP Chari-1, HC-308, UP Chari-2, HC-171, Pant Chari-8, CSV-17, Pant Chari-6, CSV-84, Pant Chari-5 and Rajasthan Chari-1 were obtained from the Department of Genetics and Plant Breeding Sardar Vallabhbhai Patel University of Agriculture and Technology, Meerut and these parental lines/varieties were pure and true to the type. All the parents were sown at Crop Research Centre of Sardar Vallabhbhai Patel University of Agriculture & Technology, Meerut during the season of *Kharif* 2018, situated at an elevation of about 237 meters above mean sea level 29º01' N latitude and 77º45' E longitude, representing the North Western Plain Zone. All the possible 45 F_1's hybrids, excluding reciprocals were made among these ten genotypes.

Results and Discussion

Analysis of variance for all the traits *i.e.*, days to 50% flowering, plant height, leaves per plant, leaf breadth, leaf length, leaf area, stem girth, leaf stem ratio, total soluble solids and green fodder yield was carried out for 'F' test (Table-1). The variance due to treatments was further partitioned in to parents, crosses and parents vs. crosses. All genotypes had highly significant variance for all the characters. Parents and crosses significantly differed among themselves for all the attributes, while parent's vs. crosses were found high significant differences for the traits *viz*., days to 50% flowering, plant height, leaf breadth, leaf length, leaf area and green fodder yield. The estimates of genotypic coefficient of variation, phenotypic coefficient of variation, heritability and genetic advance as percent of mean for different characters are given in Table-2. Genotypic coefficient of variation (more than 25%) was observed high for leaf stem ratio (28.54) and green fodder yield (29.54), whereas recorded moderate (10-25%) for plant height (11.27), leaves per plant (16.31), leaf area (12.77) and stem girth (10.17). Noted low (less than 10%) for days to 50% flowering (6.18), leaf breadth (8.29), leaf length (7.17) and total soluble solids (7.28). Phenotypic coefficient of variation (more than 25%) was estimated high for leaf stem ratio (28.92) and green fodder yield (29.58), while moderate (10-25%) was found for plant height (11.37), leaves per plant (17.14), leaf area (12.85) and stem girth (10.59). Showed low (less than 10%) for days to 50% flowering (6.36), leaf breadth (9.28), leaf length (7.54) and total soluble solids (7.66). High heritability (> 60%) recorded for all the attributes namely, days to 50% flowering (94.18), plant height (98.18), leaves per plant (90.61), leaf breadth (79.85), leaf length (90.43), leaf area (98.86), stem girth (92.23), leaf stem ratio (97.42), total soluble solids (90.44) and green fodder yield (99.61). Expected genetic advance expressed as percentage of mean was exhibited high (> 20%) for plant height (23.00), leaves per plant (31.99), leaf area (26.16), stem girth (20.11), leaf stem ratio (58.03) and green fodder yield (40.18), whereas moderate genetic advance as percentage of mean (10-20%) was revealed for days to 50% flowering (12.34), leaf breadth (15.26), leaf length (14.05) and total soluble solids (14.26).

Table 1: Analyses of variance for fodder yield and yield components in forage sorghum (*Sorghum bicolor* L. Moench)

Source of variation	df	Days to 50% flowering	Plant height (cm)	Leaves per plant	Leaf breadth (cm)	Leaf length (cm)	Leaf area (cm^2)	Stem girth (mm)	Leaf stem ratio	Total soluble solids (%)	Green fodder yield (g/plant)
Replication	2	3.40	36.58	0.54	0.09	0.98	19.92	1.28	0.18	0.08	6.55
Treatment	54	86.70**	2559.73**	11.31**	0.93**	75.87**	4877.80**	9.344**	0.24**	1.57**	20589.51**
Parents	9	196.52**	3447.47**	18.72**	1.50**	155.34**	9051.52**	14.00**	0.41**	1.49**	29723.32**
Crosses	44	66.15**	2420.39**	10.05**	0.81**	61.09**	4135.04**	8.60**	0.54**	0.99**	19026.64**
Parents vs. Crosses	1	2.38**	701.10**	0.02	0.88**	10.52**	0.89**	0.06	0.08	0.40	7158.15**
Error	108	1.75	15.73	0.38	0.07	2.59	18.75	0.26	0.000	0.036	26.90

* Significant at 5% and 1% level, respectively

Table 2: Phenotypic coefficient of variation (PCV), genotypic coefficient of variation (GCV), heritability and genetic advance as (%) of mean in forage sorghum (*Sorghum bicolor* L. Moench)

Sl. No.	Parameters	GCV (%)	PCV (%)	Heritability (%)	Genetic Advance	Genetic Advance value (%) means
1.	Days to 50% flowering	6.18	6.36	94.18	10.64	12.34
2.	Plant height (cm)	11.27	11.37	98.18	59.44	23.00
3.	Leaves per plant	16.31	17.14	90.61	3.74	31.99
4.	Leaf breadth (cm)	8.29	9.28	79.85	0.98	15.26
5.	Leaf length (cm)	7.17	7.54	90.43	9.68	14.05
6.	Leaf area (cm^2)	12.77	12.85	98.86	82.43	26.16
7.	Stem girth (mm)	10.17	10.59	92.23	3.44	20.11
8.	Leaf stem ratio	28.54	28.92	97.42	0.18	58.03
9.	Total soluble solids (%)	7.28	7.66	90.44	1.14	14.26
10.	Green fodder yield (g/plant)	29.54	29.58	99.61	70.22	40.18

Conclusion

Present investigation entitled "Combining ability and heterosis analysis in relation to yield and yield contributing traits in forage sorghum (*Sorghum bicolor* L. Moench)" was conducted to carried out the genetic analysis of breeding material through components of variance, genetic variability, character association, path analysis, nature and magnitude of gene effects, general and specific combining ability effects and heterosis among yield and it components in parents and cross combinations. Analysis of variance for parents and crosses showed highly differed significantly for all the characters *i.e.*, days to 50% flowering, plant height, leaf breadth, leaf length, stem girth, leaves per plant, leaf area, leaf stem ratio, total soluble solids and green fodder yield. Parents vs. crosses exhibited highly significant for the attributes namely, days to 50% flowering, plant height, leaf breadth, leaf length, leaf area and green fodder yield, which indicated that wide genotypic differences among the parental lines and F_1's hybrids. High heritability coupled with high genetic advance as percent of mean was observed for the traits *viz.*, plant height, and leaves per plant, leaf area, stem girth, leaf stem ratio and green fodder yield, suggesting that the genes governing these characters may have additive effect.

Reference:

1. Aksel R, Johnson LPV. Analysis of diallel cross: A worked example. Advancing Frontiers PI. Sci 1963;2:37-53.
2. Croxton, Cowden. Applied General Statistics, New Delhi, Prentice-Hall of India1964.
3. Crumpacker DW, Allard RW. A diallel cross analysis of heading date in wheat. Helgardia 1962;32:275-318.
4. Damor HI, Parmar HP, Gohil DP, Patel AA. Genetic variability, character association, path coefficient in forage sorghum (Sorghum bicolour L. Moench), Green Farming 2018;9(2):218-223.
5. Dewey DR, Lu KH. A correlation and path coefficient analysis of components of crested wheat grass seed production. Argon. Journal 1959;1:515-518.
6. Endalamaw C, Adugna A, Mohammed H. Correlation and path coefficient analysis of agronomic and quality traits in a bioenergy crop, sweet sorghum (*Sorghum bicolor* L. Moench). African Journal of Biotechnology 2017;16(47):2189-2200.
7. Griffing B. Concepts of general and specific combining ability in relation to diallel crossing systems. Anst. J Biol. Sci 1956;9:463-493.
8. Hayman BI. The analysis of variance of diallel crosses. Biometrics 1954;10:235-244.
9. Ingle KP, Gahukar SJ, Khelurkar VC, Ghorade RB, Kalpande VV, Jadhav PV et al. Heterosis and combining ability for grain yield trait in rabi sorghum (Sorghum bicolor L. Moench) using line x tester mating design. International Journal of Current Microbiology and Applied Sciences 2018;6:1925-1934.
10. Jinks JL, Hayman BI. The analysis of diallel crosses. Maize Genetics Coop. News Letter 1953;27:48-54.
11. Panse VG, Sukhatme PV. Statistical methods for agricultural workers. Indian Council of Agricultural Research, New Delhi 4th edition 1967,235-257.
12. Rajendra Shrotria PK, Bhajan R, Pandey PK. Heterosis and inbreeding depression in sorghum. Indo-Am. J Agric. and Vet. Sci 2017;5(3):9-20.
13. Robinson HF, Comstock RE, Harvey PH. Estimates of heritability and the degree of dominance in corn. Agron. J 1949;41:353-359.
14. Singh A, Singh SK, Chand P, Kerkhi SA, Kumar M, Singh RV. Variability, character association and path analysis studies in forage sorghum, Journal of Plant Development Science 2017;9(7):691-694.
15. Soujanya T, Shashikala T, Umakanth AV. Heterosis and combining ability studies in sweet sorghum (Sorghum bicolor L. Moench) hybrids for green fodder yield and quality traits. Forage Research 2018;3(4):255-260.
16. Vekariya KJ, Patel DA, Kugashiya KG, Nanavati JI. Study of combining ability and gene action for forage yield and its component characters in forage sorghum (Sorghum bicolor L. Moench). Journal of Pharmacognosy and *Phytochemistry* 2017;6(4):43-47.