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EVALUATION FOR GENETIC VARIABILITY, CORRELATION AND PATH COEFFICIENT IN MUTANT POPULATION OF FORAGE SORGHUM (*SORGHUM BICOLOR* L. MOENCH)

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ABSTRACT

An investigation was carried out with multicut forage sorghum variety SSG 59-3 and its 15 mutants derived from gamma irradiation to study the variability parameters, correlations and path coefficient analysis for green fodder yield per plant per day and their component traits. Out of 41 significant characters, magnitude of GCV ranged from 0.71 to 42.42 per cent, PCV ranged from 0.73 to 47.70 per cent, heritability (in broad sense) ranged from 31.45 to 96.23 per cent and genetic gain ranged from 1.44 to 77.71 percent at different cuts. High genetic gain were observed for early vigour (63.68) at first cut; early vigour (62.37) followed by regeneration (51.68) and number of tillers per plant (40.36) at second cut and regeneration (77.71) followed by early vigour (44.66) and green fodder yield per plant per day (49.30) at third cut, indicating the prevalence of additive gene action for inheritance of these traits. Dry matter accumulation and dry stem weight per plant at 30 DAS (0.81), number of leaves per plant (0.58) and N content in root (0.51) at first cut; dry matter accumulation per plant at 30 DAFC (0.97) and dry leaf weight per plant at 30 DAFC (0.76) and leaf length (0.53) at second cut and; early vigour (0.97), number of tillers per plant (0.92), plant height (0.90), regeneration (0.85), leaf length (0.82), root volume (0.72), stem girth (0.68) and dry root weight (0.50) at third cut, were positively and significantly correlated at genotypic level only with green fodder yield per plant per day or its sister characters. These correlated characters also had correlation between them at different cuts. Root volume (1.42), stem girth (0.91) and leaf length (0.74) have positive and high direct effect on green fodder yield per plant per day at third cut, indicating importance of these characters and can be strategically used to improve the green fodder yield of sorghum.

INTRODUCTION

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). Whereas milk production of the country is only about 108.5 million tonnes in 2008-09 (Economic Survey, 2008-09). This could be due to non-availability of nutritive fodder in adequate quantity. Hence the milk production in country can be increased by providing nutritive fodder having good quality.

To overcome such 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). The estimates of correlations alone may be often misleading due to mutual cancellation of component traits. So, it becomes necessary to study path coefficient analysis, which takes in to account the casual relationship in addition to degree of relationship (Mahajan *et al.*, 2011). In such case, path coefficient analysis is an important technique for partitioning the correlation coefficient in to direct and indirect effect of independent variables on dependent variable. Ikanovic *et al.* (2011) concluded that even if correlation values are similar for certain pairs of traits, direct effects for some of them and especially indirect effects via other traits can differ for some traits. It is therefore, genetic variability as well as correlation and path coefficient may be important tools for the breeder to enhancing the fodder yield of sorghum. The present study was conducted to assess genetic variability, heritability and path coefficient analysis fodder yield and its component characters to provide necessary information that could be useful in sorghum improvement programmes aimed at improving green fodder yield.

MATERIALS AND METHODS

The present field experiment on forage sorghum [*Sorghum bicolor* (L.) Moench] was conducted during summer-2010 at Instructional Farm of Rajasthan College of Agriculture, MPUAT, Udaipur (Rajasthan). The experimental material comprised of 15 mutants obtained through mutation breeding (M_5 generation) by the use of gamma-rays *viz*., SSG 222, SSG 224, SSG 225, SSG 226, SSG 227, SSG 231, SSG 232, SSG 233, SSG 234, SSG 236, SSG 241, SSG 244, SSG 253, SSG 256 and SSG 263 along with its parent SSG 59-3, popular variety of multicut forage sorghum, were planted in randomized block design with three replications. Each genotype had four rows of 4m length with 25cm row to row and 15cm plant to plant spacing. The recommended cultural were adopted for raising the good crop. The observations were recorded for 28 different characters (total 71 characters at different cuts) on five randomly selected plants for each genotype in each replication, except early vigour and regeneration which were on population basis. Observations on green fodder yield per plant per day and their component characters were recorded at first cut 60 days after sowing (DAS), second cut 45 days after first cut (DAFC) and third cut 45 days after second cut (DASC). Nitrogen and carbohydrate content in root; and quality parameters *viz*., crude protein, crude fibre, ether extract, nitrogen free extract, ash and TDN were estimated at first cut; and root weight and root volume at third cut only. In order to have an idea about pattern of dry matter accumulation, the observations on this traits were recorded at different stages including three at first cut (30 DAS, 45 DAS and 60 DAS), two at second cut (30 DAFC and 45 DAFC) and two at third cut (30 DASC and 45 DASC).

The replication wise mean values of the genotypes were subjected to analyse the variability, correlation coefficient was estimated as per method suggested by Fisher (1954) and Al-Jibouri *et al*. (1958) for all the characters. Path coefficient was calculated as per procedure prescribed by Dewey and Lu (1959) at third cut only.

RESULTS AND DISCUSSION

Analysis of variance revealed significant differences among the genotypes for 41 characters out of 71 characters studied at different cuts (Table 1). Out of these significant characters, magnitude of GCV ranged from 0.71 to 42.42 per cent, PCV ranged from 0.73 to 47.70 per cent, heritability in broad sense from 31.45 to 96.23 per cent and genetic gain ranged from 1.44 to 77.71 percent at different cuts (Table 2).

High variability (GCV and PCV) and heritability along with high genetic gain was observed for nitrogen content in root and early vigour at first cut; early vigour, number of tillers per plant and HCN content at second cut; and nitrogen content in plant at third cut. Therefore, selection will be effective in these characters. Similar results were also reported by Jhadav *et al*. (2011) for HCN content.

However, dry leaf weight at 30 DAFC and regeneration at second cut; and green fodder yield per plant per day, fresh root weight, dry root weight, early vigour, plant height and number of tillers per plant at third cut estimates high variability (GCV and PCV) as well as high genetic gain but the heritability was moderate (between 50 to 70 per cent). These traits were relatively more influenced by environmental fluctuations so the indirect selection through component characters will be a better approach.

Using the variability parameters we can identify the characters having high response to selection whether it has any economic importance or not. Whereas, plant breeders are mainly interested in characters having economic importance. If these characters have less variability, improvement through direct selection is difficult. These characters can be improved by indirect selection. For indirect selection, identification of component character is essential. The genotypic and phenotypic correlation coefficients are helpful in identification of such characters.

In present investigation, there was a close agreement between genotypic and phenotypic correlation coefficients. However, the values of genotypic correlation coefficients were slightly higher than the corresponding phenotypic correlation coefficients in most of the cases. This indicated that the effect of environment was different. Higher values of genotypic correlation than their corresponding phenotypic correlation may be due to the masking effect of environment on the expression of genotypes.

Difference between genotypes for green fodder yield per plant per day at first and second cut were non-significant therefore, correlation with its sister character i.e. dry matter accumulation per plant per day at 45 DAS and at harvest were considered at first and second cut, respectively.

At first cut, dry matter accumulation per plant at 45 DAS was positively correlated with dry stem weight per plant at 30 DAS ($r_g = 0.81$, $r_p = 0.85$) and 45 DAS ($r_p = 0.95$), dry matter accumulation per plant at 30 DAS ($r_g = 0.81$, $r_p = 0.85$), number of leaves per plant ($r_g = 0.58$) and nitrogen content in root ($r_g = 0.51$) while it was negatively correlated with HCN content ($r_g = -0.61$). Similarly, significant and positive correlation was also reported for green fodder yield with number of leaves per plant by Kumar and Singh (2012) and, Jain and Patel (2013). These correlated characters also had correlation between them. The association of dry matter accumulation per plant with dry stem weight per plant at 30 DAS ($r_g = 0.99$ and $r_p = 0.96$), dry stem weight per plant at 30 DAS with its 45 DAS ($r_g = 0.75$ and $r_p = 0.82$) and; number of leaves per plant with dry matter accumulation per plant at 30 DAS ($r_g = 0.81$) and with dry stem weight per plant at 30 DAS ($r_g = 0.77$) was positive and significant while, the correlation of HCN with N content in root ($r_g = -0.80$ and $r_p = -0.75$) and with number of leaves per plant ($r_g = -0.64$) was negative.

At second cut, dry matter accumulation per plant at harvest was positively correlated with dry leaf weight per plant at 30 DAFC ($r_g = 0.76$, $r_p = 0.65$) and at harvest ($r_p = 0.88$), dry matter

Table 1: Mean sum of squares for various characters at different cuts in forage sorghum

SN	Characters	Replication [2]	Genotype [15]	Error [30]
1	Early vigour - I cut	1.3125	3.5986**	0.4236
2	Early vigour - II cut	1.5833*	3.3208**	0.3833
3	Early vigour - III Cut	3.6458**	2.3653**	0.4903
4	Plant height - I cut	1570.3959*	474.6667	436.5
5	Plant height - II cut	193.0833	1484.4889	1060.0
6	Plant height - III Cut	4265.8960**	1491.7208**	341.4
7	Number of leaves/plant - I cut	12.0808**	1.1387**	0.4062
8	Number of leaves/plant - II cut	4.4033**	0.9026	0.6158
9	Number of leaves/plant - III Cut	5.1458*	1.6389	1.101
10	Leaf length - I cut	2.6458	64.0889*	24.6
11	Leaf length - II cut	21.3958	72.5778*	28.51
12	Leaf length - III Cut	81.3333	230.4389*	94.16
13	Stem girth - I cut	0.6175*	0.2371	0.1244
14	Stem girth - II cut	0.4075	0.1661	0.1337
15	Stem girth - III Cut	0.7656*	0.4624**	0.1554
16	Number of tillers/plant - II cut	0.0281	0.4843**	0.05482
17	Number of tillers/plant - III Cut	0.1339	1.1858**	0.2116
18	Leaf-stem ratio - I cut	0.0019	0.0017*	0.0006474
19	Leaf-stem ratio - II cut	0.0383	0.0164	0.03123
20	Leaf-stem ratio - III Cut	0.2947	0.1265	0.09964
21	Plant population/meter row length - I cut	1.8977	8.1993	1.126
22	Plant population/meter row length - II cut	2.3519	4.9301	1.458
23	Plant population/meter row length - III Cut	1.7520	7.6480	1.313
24	Regeneration - II cut	4.5208**	2.9097**	0.4097
25	Regeneration - III cut	2.0208**	3.5500**	0.2875
26	Root volume - III cut	0.2640	139.7343**	1.871
27	Fresh root weight - III cut	0.0005	0.0038**	0.0005304
28	Dry root weight - III cut	0.0000	0.0005**	6.223e-005
29	Green fodder yield/plant/day - I cut	2.6612*	0.9885	0.6823
30	Green fodder yield/plant/day - II cut	1.8404**	0.1022	0.169
31	Green fodder yield/plant/day - III Cut	0.1601*	0.1543**	0.03559
32	Dry fodder yield/plant/day - I cut	0.2721*	0.0890	0.08117
33	Dry fodder yield/plant/day - II cut	0.7058	0.2712	0.2386
34	Dry fodder yield/plant/day - III Cut	0.4130	0.2998	0.2547
35	Crude protein - I cut	0.1600	2.4789**	0.05982
36	Crude fibre - I cut	0.0878	2.2437**	0.2245
37	Ether extract - I cut	0.0008	0.0116**	0.0003463
38	Ash - I cut	0.1739	0.6691**	0.09449
39	Nitrogen free extract - I cut	1.0754**	1.3782**	0.1211
40	TDN - I cut	0.0174	0.4607**	0.005935
41	Dry matter accumulation/plant - 30 DAS	30.3333	29.9500**	9.533
42	Dry matter accumulation/plant - 45 DAS	82.3333**	39.4611**	11.84
43	Dry matter accumulation/plant - I cut	2141.5833**	436.0889	257.4
44	Dry matter accumulation/plant - 30 DAFC	346.7500**	202.9722**	63.11
45	Dry matter accumulation/plant - II cut	663.5833	818.1333**	243.3
46	Dry matter accumulation/plant - 30 DASC	0.0833	4.3056	8.172
47	Dry matter accumulation/plant - III cut	15.0833	22.8389	29.57
48	Dry stem weight/plant - 30 DAS	20.5833*	16.1778**	3.961
49	Dry stem weight/plant - 45 DAS	36.3333**	30.0444**	6.378
50	Dry stem weight/plant - I cut	1335.2500**	319.9500	204.1
51	Dry stem weight/plant - 30 DAFC	29.2500	64.5722	33.87
52	Dry stem weight/plant - II cut	278.5833	333.3722*	140.3
53	Dry stem weight/plant - 30 DASC	0.7500	1.6389	2.972
54	Dry stem weight/plant - III cut	19.0000	10.4667	11.0
55	Dry leaf weight/plant - 30 DAS	1.7500	3.1056	1.839
56	Dry leaf weight/plant - 45 DAS	9.3333*	2.0389	2.489
57	Dry leaf weight/plant - I cut	97.3333**	18.7056	11.29
58	Dry leaf weight/plant - 30 DAFC	181.7500**	49.9333**	12.15
59	Dry leaf weight/plant - II cut	232.7500**	121.8167**	35.15
60	Dry leaf weight/plant - 30 DASC	0.5833	1.9556	2.539
61	Dry leaf weight/plant - III cut	2.5833	4.8389	8.272
62	HCN content - I cut	1.5625	4553.2984**	122.7
63	HCN content - II cut	16.1458	3653.0208**	71.15

Table 1:

64	HCN content - III cut	118.7500	865.4167**	52.08
65	N content in plant - I cut	0.0047	0.0639**	0.001435
66	N content in plant - II cut	0.0009	0.0519**	0.0007865
67	N content in plant - III cut	0.0010	0.0400**	0.0007954
68	N content in root - I cut	0.0018	0.0367**	0.0007354
69	Carbohydrate content in root - I cut	0.7408	4.1572**	1.283
70	Total soluble sugars - I cut	3.3958	1.6431	5.218
71	Total soluble sugars - II cut	0.5625	0.8764	3.785

*,** Significant at 5 % and 1 % level, respectively

Table 2: Variability, heritability (broad sense) and genetic gain for various characters at different cuts in forage sorghum

S.N.	Characters	GCV	PCV	$H_{(BS)}$	GG
1	Early vigour - I cut	36.58	43.28	71.42	63.68
2	Early vigour - II cut	35.71	42.13	71.87	62.37
3	Early vigour - III Cut	28.97	38.7	56.04	44.67
4	Plant height - III Cut	22.83	31.39	52.9	34.2
5	Number of leaves/plant - I cut	4.29	7.00	37.54	5.42
6	Leaf Length - I cut	4.19	7.09	34.85	5.09
7	Leaf Length - II cut	4.97	8.52	34.01	5.97
8	Leaf Length - III Cut	12.36	21.66	32.55	14.52
9	Stem girth – III Cut	12.3	19.53	39.71	15.97
10	Number of tillers/plant - II cut	23.04	27.1	72.31	40.36
11	Number of tillers/plant - III Cut	21.74	27.94	60.54	34.85
12	Leaf-stem ratio - I cut	9.52	15.94	35.65	11.71
13	Regeneration - II cut	30.64	37.42	67.04	51.68
14	Regeneration - III cut	42.42	47.7	79.09	77.71
15	Root volume - III cut	12.62	12.87	96.09	25.48
16	Fresh root weight - III cut	16.3	19.91	67.08	27.51
17	Dry root weight - III cut	21.39	25.7	69.31	36.69
18	Green fodder yield/plant/day - III Cut	32.98	45.45	52.66	49.3
19	Crude protein - I cut	12.58	13.04	93.09	25.01
20	Crude fibre - I cut	2.57	2.97	74.99	4.59
21	Ether extract - I cut	3.51	3.67	91.55	6.93
22	Ash content - I cut	5.74	7.01	66.97	9.68
23	Nitrogen free extract - I cut	1.26	1.43	77.58	2.28
24	TDN - I cut	0.71	0.73	96.23	1.44
25	Dry matter accumulation/plant - 30 DAS	13.94	21.61	41.65	18.54
26	Dry matter accumulation/plant - 45 DAS	10.45	15.8	43.73	14.23
27	Dry matter accumulation/plant - 30 DAFC	17.56	26.95	42.49	23.58
28	Dry matter accumulation/plant - II cut	19.05	28.7	44.06	26.05
29	Dry stem weight/plant - 30 DAS	15.13	21.26	50.69	22.2
30	Dry stem weight/plant - 45 DAS	15.32	20.6	55.3	23.47
31	Dry stem weight/plant - II cut	17.91	31.94	31.45	20.69
32	Dry Leaf weight/plant - 30 DAFC	24.06	33.72	50.9	35.36
33	Dry Leaf weight/plant - II cut	19.28	28.71	45.11	26.68
34	HCN content - I cut	13.77	14.33	92.33	27.26
35	HCN content - II cut	14.78	15.21	94.38	29.57
36	HCN content - III cut	9.51	10.38	83.88	17.94
37	Nitrogen content in plant - I cut	12.65	13.08	93.55	25.21
38	Nitrogen content in plant - II cut	13.67	13.98	95.59	27.54
39	Nitrogen content in plant - III cut	14.8	15.25	94.26	29.6
40	Nitrogen content in root - I cut	15.23	15.69	94.21	30.44
41	Carbohydrate content in root - I cut	1.49	2.28	42.76	2.00

accumulation per plant at 30 DAFC (r_g=0.97, r_p=0.82), dry stem weight at harvest (r_p=0.96) and leaf length (r_g=0.53). Similarly, significant and positive correlation was also reported for green fodder yield with leaf length by Jain and Patel (2013). The correlation between above correlated characters at second cut was also positive. The correlation of dry stem weight per plant with dry leaf weight per plant at at 30 DAFC (r_g=0.67 and r_p=0.54) and at harvest (r_g=0.97 and r_p=0.73), dry matter accumulation per plant with dry leaf weight per plant at 30 DAFC (r_g=0.89 and r_p=0.77) and at harvest (r_g=0.75), leaf length with dry leaf weight per plant at 30 DAFC (r_g=0.61), dry matter accumulation per plant at 30 DAFC with dry stem weight per plant at harvest (r_p=0.87) and dry leaf weight per plant at 30 DAFC with dry leaf weight per plant at harvest (r_p=0.73) was positive and significant.

At third cut, green fodder yield per plant per day was positively correlated with early vigour (r_g=0.97, r_p=0.65), plant height (r_g=0.90, r_p=0.66), regeneration (r_g=0.85, r_p=0.63), root

Table 3: Genotypic path coefficient of different traits on green fodder yield per plant per day at third cut

S.N.	Characters	Early vigour	Plant height	Leaf length	Stem girth	Number of tillers/ plant	Regen eration	Root volume	HCN content	Nitrogen content in plant	R
1	Early vigour	-0.10	-0.80	0.75	0.41	-0.62	-0.04	1.34	0.37	-0.34	0.97**
2	Plant height	-0.09	-0.93	0.57	0.40	-0.52	-0.03	1.14	0.50	-0.15	0.90**
3	Leaf length	-0.10	-0.72	0.74	0.44	-0.61	-0.04	1.30	0.24	-0.43	0.82**
4	Stem girth	-0.04	-0.40	0.36	0.91	-0.08	-0.01	0.25	-0.33	0.02	0.68**
5	Number of tillers/plant	-0.10	-0.79	0.74	0.12	-0.61	-0.04	1.57	0.46	-0.44	0.92**
6	Regeneration	-0.10	-0.85	0.76	0.24	-0.62	-0.04	1.31	0.44	-0.30	0.85**
7	Root volume	-0.09	-0.74	0.68	0.16	-0.67	-0.03	1.42	0.31	-0.31	0.72**
8	HCN content	0.03	0.34	-0.13	0.22	0.21	0.01	-0.32	-1.35	0.67	-0.33
9	Nitrogen content in plant	-0.03	-0.14	0.33	-0.01	-0.28	-0.01	0.46	0.95	-0.96	0.30

Residual effect = 0.3375; Bold values indicate direct effect; *, ** Significant at 5 % and 1 % levels, respectively

volume (r_g=0.72, r_p=0.52), number of tillers per plant (r_g=0.92), leaf length (r_g=0.82), stem girth (r_g=0.68) and dry root weight (r_g=0.50). Similarly, significant and positive correlation for green fodder yield with one or more above characters was also reported by Iyanar *et al*. (2010), Jain *et al*. (2010), Prakash *et al*. (2010) and Jain and Patel (2013). The correlation between these correlated characters was also positive. Early vigour was positively correlated with dry root weight (r_g=0.98 and r_p=0.52), with root volume (r_g=0.94 and r_p=0.64), with plant height (r_g=0.87 and r_p=0.71), with regeneration (r_p=0.79), with number of tillers per plant (r_p=0.70) and with leaf length (r_p=0.67). Regeneration was positively correlated with root volume (r_g=0.92 and r_p=0.60), with plant height (r_g=0.91 and r_p=0.75), with dry root weight (r_g=0.80 and r_p=0.53), with number of tillers per plant (r_p=0.81) and with leaf length (r_p=0.59). Plant height was positively correlated with number of tillers per plant (r_g=0.88 and r_p=0.54), with root volume (r_g=0.80 and r_p=0.53), with leaf length (r_g=0.78 and r_p=0.51) and with dry root weight (r_g=0.70). Dry root weight was positively correlated with root volume (r_g=0.69 and r_p=0.66), with number of tillers per plant (r_g=0.81) and stem girth (r_p=0.58). Root volume was correlated positive and significant with leaf length (r_g=0.92) and with number of tillers per plant (r_p=0.79). However, the positive and significant correlation was also found between leaf length and stem girth (r_p=0.53).

The above correlation coefficients provide relationship between the characters at same cut only. To predict the performance in next cut, correlation between characters of different cuts is essential. Accordingly correlation between characters of different cuts was calculated. The correlation was positive and significant for HCN content (r_g=1.00 and r_p=0.93), early vigour (r_g=0.99 and r_p=0.97), nitrogen content in plant (r_g=0.99 and r_p=0.96) and leaf length (r_g=0.64) at second cut with their values in first cut. Similarly, nitrogen content in plant (r_g=0.96 and r_p=0.91), HCN content (r_g=0.87 and r_p=0.74), leaf length (r_g=0.68) and early vigour (r_p=0.64) at third cut had significant positive correlation with their values in first cut. Likewise, nitrogen content in plant (r_g=0.98 and r_p=0.97), number of tillers (r_g=0.96 and r_p=0.75), HCN content (r_g=0.87 and r_p=0.75), leaf length (r_g=0.70), regeneration (r_p=0.75) and early vigour (r_p=0.61) at third cut had also positive and significant correlation with their values in second cut. So performance of these characters in third or second cut can be predicted in previous cut (s) in advance. Though other characters did not had correlation with their values in previous cuts but had correlation with other characters. Dry matter accumulation per plant at harvest during second cut was positively correlated with leaf length (r_g=0.69) and nitrogen free extract (r_g=0.62) at first cut. Similarly, green fodder yield per plant per day at third cut was positively correlated with early vigour (r_g=0.83) while negatively correlated with leaf-stem ratio (r_g=-0.58) of first cut and with number of tillers (r_g=0.91), early vigour (r_g=0.82) and regeneration (r_g=0.77) of second cut. Therefore values of these characters can be predicted on the basis of their correlated characters in previous cut (s).

Information obtained from correlation studied does not provide a clear picture of contribution of each component character. At the same time, as more variables are included in association studies, the direct association becomes complex. Under such situation, path coefficient analysis is useful in partitioning direct and indirect causes of correlation and allows a detailed examination of specific forces acting to produce a given correlation. Simultaneously, it also measures the relative importance of each causal factor, thereby provides a realistic basis for allocation of weightage to attributes in deciding a suitable criterion for exercising indirect selection.

In present study, difference between genotypes for green fodder yield per plant per day was not significant at first and second cut therefore path coefficient was computed at third cut only taking nine independent characters. The residual effect (R=0.3375) indicated that about 66 per cent variability of green fodder yield per plant per day could be explained by the characters under consideration. Out of the seven characters *i.e.* early vigour, plant height, leaf length, stem girth, number of tillers, regeneration and root volume, which were positively correlated with green fodder yield per plant per day, only three traits *viz*., root volume (1.42), stem girth (0.91) and leaf length (0.74) had positive and high direct effects (Table 3). Similarly, positive and high direct effect were reported of leaf length for green fodder yield by Prakash *et al*. (2010) and, Kumar and Singh (2012) while of stem girth for green fodder yield were reported by Prakash *et al*. (2010), Iyanar *et al*. (2010) and Jain *et al*. (2010). Hence, these three characters may be considered as selection indices in sorghum breeding programme for improving the green fodder yield per plant per day at third cut. While indirect effects of root volume via leaf length (0.68), HCN content (0.31) and stem girth (0.16) and, indirect effects of stem girth via leaf length (0.36) and root volume (0.25) was positive and high. Likewise, indirect effect of leaf length via root volume (1.30), stem girth (0.44) and HCN content (0.24) was also positive and high.

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