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Evaluation of Morphological Determinants of Fodder Yield as a Selection Criterion in Induced Mutants of Oat (*Avena sativa* L.)

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ABSTRACT: *Seventeen morphological traits were studied on the 59distinct mutant lines in the* M_5 *generation along with parental genotype JO-1. GCV and PCV were higher for spikelets/ plant, tillers/plant, crude protein yield/day and leaf area. High heritability accompanied by high genetic advance for spikelets/panicle, dry matter yield, green fodder yield and leaf area; indicated the predominance of the additive gene action for the expression of these characters. Total green fodder yield was found positive and significantly correlated with green fodder yield/day, dry matter yield/day, crude protein yield, crude protein yield/ day and leaf area at both phenotypic and genotypic levels indicating the importance of these characters for fodder yield improvement in this population.Dry matter yield had highest positive direct effect on green fodder yield followed by crude protein yield, green fodder yield/day, axis length, stem girth, leaf area, tillers/plant, plant height, leaves/plant and internode length. The selection favoring higher such traits would help to achieve higher total green fodder yield in this population of oat.*

Key words: *Correlation, Genotype, Mutant, Oat, Path coefficient, Phenotype*

INTRODUCTION

The live stock sector valued as one of the global drivers of agriculture having enormous potential for poverty reduction in India. Integration of agriculture and animal husbandry is unique on account of rich and diversified cultural environment. Oat (*Avena sativa* L.) is a constituent of family Gramineae, a natural allohexaploid (2n = 6x =42). The crop ranks sixth in world cereal production and is widely cultivated for fodder (as hey and silage) and feed for several years that accounts for at least 60 per cent of the total world production and only 13 per cent is used for food production. The nutritive value of oat forage is high and dry matter digestibility is in excess of 75 percent when fed to dairy cattle (Burgess *et al.*, 1972). The cereal straws have similar chemical compositions but oat straw has more digestible organic matter and metabolizable energy (Cuddeford, 1995). Oat straw is softer and more acceptable to livestock than are other cereal straws.Compared to other small grain cereal crops, oat is reputed to be better suited for production under marginal environments, including cool-wet climates and soils with low fertility (Hoffmann, 1995).

Availability and creation of variation in the desired direction is pre-requisite for crop improvement programme. Low genetic variability in cultivated species hampers the selection of superior genotypes for breeding (Silva *et al*. 1998).Induced mutation has proved to be of valuable approach in creating the variability for breeding improved varieties. Mutation breedinghas been used in the 20th century as a valuable supplement to the conventional methods of plant breeding in generating the variability and development of crop plant of new architecture.Over the last seven decades, more than 2250commercial mutants varieties, used directly or throughcontrolled crosses, have been created (Ahloowalia*et al*. 2004).Cultivation of oats as fodder crop during Rabi season during the last two decades has become very popular. Only a few varieties are available for cultivation and their yield vary between 25-30t/ha (Mushtaq*et al.*, 2013). Development of high yielding varieties of oat with higher palatability therefore, assumed greater importance.

MATERIALS AND METHODS

Dry seeds of oat variety JO-1 irradiated with four different doses of gamma rays viz. 150, 200, 300 and

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400Gray (1 Gray=1 joule per kg of matter undergoing radiations=0.1kR) at Gamma chamber Jawaharlal Nehru KrishiVishwaVidyalaya, Jabalpur (M.P.), India.

Plant selectionin M_1, M_2, M_3 and M_4 generations were made. Seeds from the prospective mutant plants of M_4 generation, which were morphologically different from each other and from their parent genotype, were used for raising M_5 generation. Total of selected 59 M_5 entries along with parent genotype were sown in randomized complete block design (RCBD) with three replications at seed breeding farm, JNKVV, Jabalpur.Each plot consisted of 3 rows of 3 m length with spacing of 5 x 30 cm.Standard agronomic practices were followed to raise a healthy crop. The observations were recorded on the following characters VIZ:daysto harvest, leaves/plant, plant height (cm), internode length (cm), stem girth (cm), peduncle length (cm), axis length (cm), spikelets/panicle, tillers/plant,leaf area (cm^2), leaf:stem ratio, green fodder yield/day, dry matter yield (kg), dry matter yield/day (kg), crude protein yield (kg), crude protein yield/day (kg) and total green fodder yield (kg)on ten plants selected randomly from each replication.

The data were subjected to statistical analyses for variances, mean, range and coefficient of variability (Panse and Sukhatme, 1967), Correlation coefficient (Searle, 1961), and path coefficient analysis (Dewey and Lu, 1959).

RESULT AND DISCUSSION

The analysis of variance of the 59 mutant entries and their parental genotype with respect to 17 traits revealed that the mean sum of squares due to mutant genotypes were highly significant for almost all the characters studied indicating considerable genetic variability among the experimental material (Table 1).

The results revealed that genotypic coefficient of variation (GCV) and phenotypic coefficient of variation (PCV) were high for spikelets/plant and tillers/plant; moderate for crude protein yield, dry matter yield/day, dry matter yield, green fodder yield/day,green fodder yield and axis length; and low for internode length, leaves/plant, plant height, stem girth, peduncle length, leaf stem ratio and days to harvest (Table 2). Similar results have been reported by Taylor *et al.* (1995) for late maturity and tallness and by Park *et al*. (2006) for earliness and forage yield. Coimbra *et al* (2007) for days to harvest, Mehta *et al* (2008) for dwarfness, early maturity, tillers per plant, plant height, in oat and Yu *et al* (2007) for plant height, days to maturity and panicle length in treated population. Differences between PCV and GCV for the studied characters was very less, indicating low sensitivity to the environment and consequently greater role of genetic factors influencing the expression of these characters, which led to high estimates of broad sense heritability for all the characters except leaf stem ratio. Similar results for heritability from the studies on induced mutants in sorghum have been reported for different yield components but results obtained for genetic advance were contrary to the present findings (Larik *et al.*, 2009). The estimates of genetic advance as percent of mean were high for spikelets/panicle, dry matter yield, green fodder yield/day, leaf area, total green fodder yield and crude protein yield; and low for days to harvest. High heritability accompanied by high to moderate genetic advance for spikelets/panicle, dry matter yield, green fodder yield, leaf area, axis length, green fodder yield/day, crude protein yield, plant height and crude protein yield/day indicated the predominance of additive gene action for the expression of these characters. Therefore selection for the above characters would be rewarding. The results are in agreement with the findings of Srivastava *et al.* (1995), Roy *et al.* (2006) and Bahadur *et al.* (2008).

The basic requirement of any selection programme is to ascertain the nature and magnitude of interrelationship between yield and its component traits and also among the different traits. It was therefore, considered imperative to carry out correlation studies for various quantitative traits that contributed to fodder yield. Correlation coefficients estimates between all pairs of variables used in this experimentis shown in Table 3. The estimates revealed that genotypic correlation coefficients were higher in magnitude than the corresponding phenotypic correlation coefficients. Very close values of genotypic and phenotypic correlations were observed between some character combinations such as total green fodder yield with dry matter yield/day, total dry matter yield, green fodder yield/day, leaf stem ratio and with leaf area, which might be due to reduction in the error variance to the minor proportions as reported by Dewey and Lu (1959). Wide differences between genotypic and phenotypic correlation between two characters is due to dual nature of phenotypic correlation which is determined by genotypic and environmental correlations and heritability of the character (Falconer, 1981). Total green fodder yield was found to be positively and significantly correlated with green fodder yield/day,

Table 1
Analysis of Variance for Seventeen Traits in Induced Mutants of Oat

Character	*Source of variation*		
	Replication	*Treatment*	*Error*
Degree of freedom	2	59	118
Day to harvest	23.46	18.797**	2.957
Leaves/plant	74.202	195.643**	22.375
Plant height (cm)	3.118	1.26*	0.194
Internode length (cm)	2.91	4.311**	0.577
Stem girth (cm)	0.032	1.267*	0.081
Peduncle length (cm)	0.03	6.594**	1.56
Axis length (cm)	321.33	1983.14**	119.64
Spikelets/panicle	2.09	1.31*	1.02
Tillers/plant	20.885	19.207**	4.553
Leaf area (cm^2)	0.311	48.220**	3.51
Leaf stem ratio	55.878	4218.93**	15.303
Green fodder yield /day	2.02	1.28*	0.84
Dry matter yield (kg)	1.484	2.934**	0.063
Dry matter yield /day (kg)	0.81	1.353*	0.49
Crude protein yield (kg)	0.028	1.320*	0.002
Crude protein yield/day (kg)	0.22	1.048	0.191
Total green fodder yield (kg)	28.236	59.061**	1.352

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

dry matter yield, dry matter yield/day,crude protein yield, crude protein yield/day and leaf area at both phenotypic and genotypic levels. However, stem girth, leaves/plant, tillers/plant and leaf: stem ratio showed significant correlation only at genotypic level. These results indicating the importance of these characters for fodder yield improvement in this population and based on these results it seems possible that the simultaneous selection of these traits for improvement in forage yield in the present set of material would be erective. Similar results were reported earlier by Srivastava *et al.* (1995), Roy *et al.* (2006), Bahadur *et al.* (2008) and Mushtaq *et al.* (2013). There were few other traits those showed significant positive association are days to harvest with stem girth and leaf area; Leaves/plantwith stem girth, green fodder yield, peduncle length and crude protein yield; plant height with internode length and green fodder yield; internode length with leaf: stem ratio; stem girth with green fodder yield, leaf area, tillers/ plant, dry matter yield, dry matter yield/day and crude protein yield; tillers/plant with leaf area, total dry matter yield, dry matter yield/day, green fodder yield and green fodder yield/day; leaf area with leaf: stem ratio, dry matter yield, dry matter yield/day, green fodder yield/day and crude protein yield; leaf: stem ratio with green fodder yield/day, green fodder yield and dry matter yield; green fodder yield/day with total green fodder yield, dry matter yield/day, dry matter yield and crude protein yield; dry matter yield with green fodder yield and crude protein yield; crude protein yield with green fodder yield and crude protein yield/day with total green fodder yield. These results are in agreement with Choubey and Gupta (1986), Shekhawat *et al.* (2006) and Bahadur *et al.*

Table 2
Genotypic and Phenotypic Coefficients of Variability, Heritability, and Genetic Advance for Seventeen Traits in Induced Mutants of Oat

Character	*Range*		*Mean*	*PCV*	*GCV*	*h^2 (%)*	*GA as % of mean (5%)*
	Min.	*Max.*					
Day to harvest	98	109	103.79	2.77	2.21	64.08	3.65
Leaves/plant	6.4	8.7	7.82	9.48	7.62	64.65	12.63
Plant height (cm)	92.5	124.9	112.95	7.93	6.73	72.07	11.77
Internode length (cm)	11.85	19	16.02	11.23	8.08	51.81	11.99
Stem girth (cm)	0.61	0.848	0.714	7.72	6.02	60.7	9.65
Peduncle length (cm)	31.667	41.66	37.33	8.23	5.92	51.76	8.77
Axis length (cm)	29.99	51	36.55	11.74	10.56	80.93	19.57
Spikelets/panicle	63.33	235	118.44	31.78	28.6	89.99	41.1
Tillers/plant	3.2	9.283	5.42	24.86	20.55	68.3	34.98
Leaf area (cm^2)	94.54	218.05	131.62	20.68	18.94	83.84	35.72
Leaf stem ratio	0.656	0.88	0.736	8.41	5.76	46.99	8.14
Green fodder yield /day	0.201	0.4073	0.289	15.77	12.62	80.02	30.24
Dry matter yield (kg)	3.08	8.27	5.63	17.93	15.36	85.72	34.67
Dry matter yield /day (kg)	0.029	0.0813	0.054	18.5	16.13	87.18	35.69
Crude protein yield (kg)	0.257	0.737	0.484	19.48	16.94	75.59	30.34
Crude protein yield/day (kg)	0.0023	0.007	0.0047	20.97	17.44	69.16	29.88
Total green fodder yield (kg)	21.075	41.35	29.99	15.13	12.71	84	29.11

Min.-Minimum, Max.-Maximum, h^2= Broad sense heritability

Table 3
Genotypic and Phenotypic Correlation Coefficients for Seventeen Traits in Mutants(M_5) of Oat

Sr. N.	Characters		L/P	PH	IL	SG	PL	Ax.L	S/P	T/P	LA	L/S	GFY/d	TDMY	DMY/d	CPY	CPY/ d	TGFY
1	Days to harvest	G	0.1581	0.129	-0.0116	0.557**	-0.4171**	0.149	0.1847	0.0177	0.2913*	0.1305	-0.331**	-0.1998	-0.3226**	-0.1669	-0.2146	-0.1885
		P	0.1376	0.0513	-0.0356	0.4535**	-0.2352*	0.1652	0.1552	-0.0044	0.1767	0.063	-0.2988*	-0.131	-0.2819*	-0.0097	-0.0709	-0.1255
2	Leaves/Plant	G		0.2195	-0.0656	0.2939*	0.2876*	-0.5317**	-0.506**	-0.4421**	-0.3728**	0.36**	-0.2969*	-0.26	-0.2678*	0.2530*	-0.1029	0.2919*
		P		0.1578	0.0281	0.2506	0.1204	-0.389**	-0.417**	-0.2808*	-0.2524*	0.1127	-0.1944	-0.1592	-0.1778	0.0209	-0.0003	-0.1732
3	Plant Height	G			0.3188**	0.0027	0.0663	0.0306	0.0442	0.0078	0.1653	0.1906	0.1598	0.1933	0.1754	0.1345	0.1449	0.1864
		P			0.2749*	-0.0457	0.0664	-0.0403	0.0256	-0.0131	0.1419	0.1607	0.1566	0.1869	0.1694	0.0908	0.0895	0.1765
4	Internode Length	G				-0.0368	-0.0415	-0.2565*	-0.1536	-0.1725	0.0449	0.2642*	-0.0572	-0.0999	-0.0952	0.0946	0.0998	-0.0558
		P				-0.0385	-0.0539	-0.2358*	-0.1212	-0.1358	0.0200	0.2587	0.0147	-0.0207	-0.0075	0.0524	0.0711	0.0066
5	Stem Girth	G					-0.2588*	0.0245	0.2515	0.056	0.3222**	-0.2480	-0.0514	0.0671	-0.1361	0.0747	0.0466	0.6347**
		P					-0.0751	0.0052	0.1779	-0.0153	0.2546	-0.2070	-0.0838	0.0613	-0.1318	0.0011	-0.0356	0.0002
6	Peduncle Length	G						-0.164	-0.1974	-0.038	-0.4838**	-0.2648*	0.0014	0.0755	0.1264	0.0973	0.118	-0.0660
		P						-0.1315	-0.1242	-0.029	-0.2915*	-0.1373	-0.0209	0.0268	0.0665	-0.0051	0.0333	-0.0732
7	Axis Length	G							0.8114**	0.6365**	0.6582**	0.2587*	0.2029	0.2981*	0.2722*	0.1869	0.178	0.2374*
		P							0.7344**	0.4965**	0.5073**	0.1890	0.1337	0.2317	0.1993	0.1760	0.1504	0.1740
8	Spikelets/ Panicle	G								0.4963**	0.5733**	0.3314**	0.1856	0.2945*	0.2628*	0.273*	0.2279	0.2240
		P								0.4001**	0.5211**	0.2171	0.1712	0.2795*	0.2477*	0.2422*	0.1934	0.2093
9	Tillers/ Plant	G									0.6196**	0.2197	0.2424*	0.3178**	0.3053**	0.0899	0.0938	0.2603*
		P									0.4987**	0.0652	0.1969	0.2466*	0.2500*	0.0716	0.0855	0.2080
10	Leaf Area	G										0.4849**	0.2982*	0.3489**	0.2991*	0.2333*	0.2121	0.3619**
		P										0.3069**	0.2915*	0.3348**	0.2956*	0.1957	0.1553	0.3434**
11	Leaf/ Stem	G											0.2689*	0.2579*	0.1659	0.1673	0.1248	0.2943*
		P											0.2552*	0.1542	0.1386	0.125	0.1239	0.2577
12	GFY/day	G												0.8787**	0.8940**	0.7649**	0.7766**	0.9892**
		P												0.8743**	0.8925**	0.6561**	0.6457**	0.9835**
13	DMY	G													0.992**	0.8805**	0.8929**	0.8860**
		P													0.9871**	0.7859**	0.7639**	0.8841**
14	DMY/day	G														0.8764**	0.895**	0.8794**
		P														0.761** ***	0.750** ***	0.8774**
15	CPY	G															0.995**	0.7680**
		P															0.953**	0.6805**
16	CPY/day	G																0.7739**
		P																0.6567**

* Significant at 5% level ** Significant at 1% level

Table 4
Genotypic (G) and Phenotypic (P) Path Coefficient showing Direct and Indirect Effects of Different Contributing Characters on Total Fodder Yield/plant (Kg) in Oat

S. No.	*Characters*		*DTH*	*Leaves/plt*	*Plant ht.*	*Intlth*	*SG*	*Ped L*	*Ax L*	*Spk/ P*	*T/ P*	*LA*	*L/ S*	*GFY/ day*	*TDMY*	*DMY/ day*	*CPY*	*CPY/ day*	*TGFY*
1	**DTH**	G	**-0.3481**	-0.0479	-0.0449	0.004	-0.1939	0.1452	-0.0519	-0.0643	-0.0062	-0.1014	-0.0454	0.1152	0.0695	0.1123	0.0581	0.0747	-0.1885
		P	**0.0914**	0.0144	0.0047	-0.0033	0.0414	-0.0215	0.0151	0.0142	-0.0004	0.0161	0.0058	-0.0273	-0.0120	-0.0258	-0.0009	-0.0065	-0.1255
2	**Leaves/plt.**	G	-0.0101	**0.0731**	-0.0115	0.0048	-0.0215	-0.021	0.0388	0.0370	0.0323	0.0272	0.0263	0.0217	0.019	0.0196	0.0077	0.0075	0.2919
		P	0.0003	**0.0020**	0.0004	0.0001	0.0004	0.0002	-0.0008	-0.0008	-0.0006	-0.0004	-0.0002	-0.0004	-0.0003	-0.0004	0.0000	0.0000	-0.1732
3	**Plant ht.**	G	0.012	0.0147	**0.0933**	0.0257	-0.0043	0.0062	0.0029	0.0041	0.0007	0.0132	0.0178	0.0146	0.018	0.0158	0.0126	0.0135	0.1864
		P	0.0001	0.0004	**0.0016**	0.0005	0.0000	0.0001	-0.0001	0.0000	0.0000	0.0003	0.0003	0.0003	0.0003	0.0003	0.0001	0.0001	0.1765
4	**Intlth**	G	-0.0002	-0.0011	0.0045	**0.0165**	0.0006	-0.0007	-0.0042	-0.0025	-0.0029	0.0003	0.004	-0.0009	-0.0017	-0.0016	0.0016	0.0017	-0.0558
		P	-0.0001	0.0001	0.0008	**0.0025**	-0.0001	-0.0001	-0.0006	-0.0003	-0.0003	0.0001	0.0005	0.0000	-0.0001	0.0000	0.0001	0.0002	0.0066
5	**SG**	G	0.0816	0.0431	-0.0067	0.0056	**0.1465**	-0.0379	0.0008	0.0310	0.0082	0.0472	0.0476	-0.0075	-0.0098	-0.0199	0.0002	-0.0052	0.6347
		P	0.0016	0.0008	0.0000	-0.0001	**0.0036**	-0.0003	0.0001	0.0006	-0.0001	0.0007	0.0007	-0.0003	-0.0002	-0.0005	0.0003	0.0002	0.0002
6	**Ped L**	G	0.0377	-0.0260	-0.006	0.0037	0.0234	**-0.0904**	0.0148	0.0178	0.0034	0.0437	0.0239	-0.0001	-0.0068	-0.0114	-0.0088	-0.0107	-0.0660
		P	0.0013	-0.0006	-0.0004	0.0003	0.0004	**-0.0054**	0.0007	0.0007	0.0002	0.0016	0.0007	0.0001	-0.0001	-0.0004	0.0000	-0.0002	-0.0732
7	**Ax L**	G	0.0321	-0.1147	0.0066	-0.0553	0.0011	-0.0354	**0.2157**	0.1750	0.1373	0.1419	0.0558	0.0438	0.0643	0.0587	0.0403	0.0384	0.2374
		P	0.0010	-0.0024	-0.0002	-0.0014	0.0001	-0.0008	**0.0060**	0.0044	0.0030	0.0031	0.0011	0.0008	0.0014	0.0012	0.0011	0.0009	0.1740
8	**SPK/pl**	G	-0.0475	0.1304	-0.0114	0.0395	-0.0544	0.0508	-0.2089	**-0.2574**	-0.1278	-0.1476	-0.0853	-0.0478	-0.0758	-0.0676	-0.0703	-0.0587	0.2240
		P	-0.0006	0.0016	-0.0001	0.0005	-0.0007	0.0005	-0.0028	**-0.0038**	-0.0015	-0.0020	-0.0008	-0.0006	-0.0011	-0.0009	-0.0009	-0.0007	0.2093
9	**T/P**	G	0.0018	-0.0440	0.0008	-0.0171	0.0056	-0.0038	0.0633	0.0494	**0.0994**	0.0616	0.0218	0.0241	0.0316	0.0304	0.0071	0.0093	0.2603
		P	0.0000	-0.0006	0.0000	-0.0003	0.0000	-0.0001	0.0010	0.0008	**0.0020**	0.0010	0.0001	0.0004	0.0005	0.0005	0.0002	0.0002	0.2080
10	**LA**	G	-0.0382	0.0490	-0.0186	-0.0026	-0.0423	0.0635	-0.0864	-0.0753	-0.0814	**0.1313**	-0.0637	-0.0392	-0.0458	-0.0393	-0.0306	-0.0278	0.3619
		P	0.0007	-0.0007	0.0006	0.0002	0.0008	-0.0011	0.0019	0.0019	0.0018	**0.0037**	0.0011	0.0011	0.0012	0.0011	0.0007	0.0006	0.3434
11	**L/S**	G	-0.0103	0.0285	-0.0151	-0.0193	-0.0257	0.0209	-0.0204	-0.0262	-0.0174	-0.0383	**-0.0790**	-0.0173	-0.0149	-0.0131	-0.0132	-0.0099	0.2543
		P	0.0000	-0.0001	0.0001	0.0001	0.0001	-0.0001	0.0001	0.0001	0.0000	0.0002	**0.0005**	0.0001	0.0001	0.0001	0.0001	0.0001	0.2077
12	**GFY/day**	G	-0.2997	-0.2689	0.1419	-0.0518	-0.0465	0.0012	0.1838	0.1681	0.2195	0.2700	0.1982	**0.9057**	0.7958	0.8083	0.6927	0.7034	0.9892
		P	-0.3085	-0.2007	0.1650	0.0152	-0.0865	-0.0216	0.1380	0.1768	0.2033	0.3010	0.1912	**1.0326**	0.9029	0.9232	0.6775	0.6667	0.9835
13	**TDMY**	G	-0.5365	-0.6982	0.5192	-0.2684	-0.1803	0.2028	0.8006	0.7909	0.8536	0.9372	0.5048	2.3602	**2.6858**	2.6643	2.3650	2.3983	0.8841
		P	-0.0720	-0.0874	0.1027	-0.0114	-0.0337	0.0147	0.1273	0.1535	0.1355	0.1839	0.0847	0.4803	**0.5494**	0.5423	0.4318	0.4197	0.8860
14	**DMY/day**	G	0.8778	0.7286	-0.4610	0.2590	0.3703	-0.3439	-0.7405	-0.7150	-0.8306	-0.8137	-0.4513	-2.4285	-2.6992	**-2.7210**	-2.3846	-2.4353	0.8794
		P	0.1584	0.0999	-0.0985	0.0042	0.0741	-0.0373	-0.1120	-0.1392	-0.1349	-0.1661	-0.0779	-0.5023	-0.5546	**-0.5618**	-0.4281	-0.4217	0.8774
15	**CPY**	G	-0.2689	-0.1697	0.2166	0.1524	0.0017	0.1568	0.3012	0.4398	0.1153	0.3759	0.2696	1.2325	1.4188	1.4121	**1.6113**	1.6032	0.7680
		P	-0.0001	0.0003	0.0012	0.0007	0.0010	-0.0001	0.0023	0.0032	0.0012	0.0026	0.0017	0.0088	0.0105	0.0102	**0.0133**	0.0127	0.6805
16	**CPY/day**	G	0.3281	0.1573	-0.2214	-0.1526	0.0544	-0.1804	-0.272	-0.3483	-0.1434	-0.3242	-0.1908	-1.1872	-1.3649	-1.3681	-1.5209	**-1.5286**	0.7739
		P	0.0011	0.0000	-0.0014	-0.0011	-0.0007	-0.0005	-0.0023	-0.0030	-0.0013	-0.0024	-0.0019	-0.0100	-0.0119	-0.0117	-0.0148	**-0.0156**	0.6567

Phenotypic Residual effect = 0.0273 Genotypic path matrix = Residual effect = 0.042

(2008). Positive and significant correlation of plant height with green fodder yield suggested that the taller plants would bear more biomass and therefore were result in increased fodder production through selection (Choubey and Gupta, 1986). Significant negative correlation were noted for days to harvest with dry matter yield/day, green fodder yield/day and peduncle length; Leaves/plant with dry matter yield/day, green fodder yield/day, leaf:stem ratio, leaf area, tillers/plant, spikelets/panicle and axis length; Internode length with axis length; Stem girth with leaf: stem ratio and peduncle length; Peduncle length with leaf: stem ratio and leaf area.

Considering total green fodder yield as effect and sixteen characters as causes, *i.e.* total green fodder yield conclude as an independent variable and remain as dependent variable. Genotypic correlation coefficients were partitioned by using method of path analysis to find out the direct and indirect effects of yield contributing characters towards the total green fodder yield.The path coefficient analysis of different characters revealed (Table 4) that dry matter yield had highest positive direct effect on green fodder yield followed by crude protein yield, green fodder yield/day, axis length, stem girth, leaf area, tillers/plant, plant height, leaves/plant and internode length. Negative direct effect on green fodder yield was found the highest in case of leaf: stem ratio followed by peduncle length, spikelets/panicle, days to harvest, crude protein yield/day and dry matter yield/day. These results are in agreement with the Bahadur *et al*. (2008) in fodder oat.Positive direct effect observed in the present study for different characters on fodder yield revealed that the number of tillers/plant, plant height and flag leaf length were the most important traits with high direct contribution towards green fodder yield.

CONCLUSION

From the above experiment, it can be denouement thatall the High heritability with high genetic advance wereobserved for spikelets/panicle, dry matter yield, green fodder yield and leaf area which can be further used for selection. The inter relationship between componenttraits is also valuable in selection criteria because theydirectly or indirectly influence fodder quality traitssuch as green fodder yield/day, dry matter yield/day, crude protein yield, crude protein yield/day and leaf area and should be given emphasis for future forage yield improvement programs, which can help to produce high quality fodder yielding varieties.

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