ISSN Print: 2394-7500
ISSN Online: 2394-5869
Impact Factor: 3.4
IJAR 2014; 1(1): 493-496
www.allresearchjournal.com
Received: 13-11-2014
Accepted: 01-12-2014

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Character association and path coefficient analysis in forage Oat (*Avena sativa* L.)

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Abstract
An attempt was made to study the character association and path coefficient analysis among 45 genotypes of forage oat. Highly significant differences were observed for all the traits. Genotypic and phenotypic coefficient of variation was high for almost all the fodder yield traits. Heritability was high for all the characters, whereas genetic advance was high for most of the characters. In general genotypic correlations were higher than their corresponding phenotypic correlations. Green and dry fodder yield was positive and significantly correlated with plant height, stem diameter, number of leaves/plant, leaf length and leaf breadth. Plant height and stem diameter had high direct effect on fodder yield. Both these traits also had high indirect effect. Therefore, prime importance should be given to these traits in selection for advancement of fodder yield in oat.

Keywords: Heritability, genetic advance, correlation, path coefficient, fodder traits

Introduction
Oat (*Avena sativa* L.) is an important fodder crop of India. Yield is a polygenically controlled complex character determined by number of quantitatively inherited yield components. Execution of breeding programme successfully in any crop depends on the magnitude of genetic variability present in the base population. The knowledge of association between fodder yield and its contributing traits is a basic need. Correlation coefficient provides the information on relationship between yield components, while path coefficient split the correlation coefficients into direct and indirect effects. Therefore, the present investigation was undertaken to study the component traits on which selection can be based for fodder yield improvement in oat.

Materials and Methods
Forty five diverse genotypes of forage oat were raised in a randomized block design with three replications at the experimental areas of the department of genetics and plant breeding, Research farm, Brahmanand Mahavidyalaya Rath (Hamirpur) U.P. during 2009-10.
Each genotype was grown in two rows of 4 m length spaced at 30 cm between rows and 10 cm between plants with recommended package of practices. Observations on five randomly selected plants from each genotypes in each replication were recorded on 10 metric traits *viz*., days to 50% flowering, plant height (cm), number of tillers/plant, stem diameter (mm), number of leaves/plant, leaf length (cm), leaf breadth (cm), leaf-stem ratio, green fodder yield /plant (g) and dry fodder yield/plant (g). Data were subjected to statistical analysis. Genotypic coefficient of variation, phenotypic coefficient of variation, heritability and genetic advance were calculated using the formulae as suggested by Johnson *et al*. (1955) [3]. Genotypic and phenotypic correlations were computed as per Robinson *et al*. (1951) [5] and path coefficients analysis was worked out as per Dewey and Lu (1959) [2].

Results and Discussion
Highly significant genotypic differences were observed for all the characters (Table-1). Genotypic and phenotypic coefficient of variation was high for most the traits including green and dry fodder yield/plant.

Both these parameters were quite close to each other. Heritability was high for all the traits indicating lesser environmental effect and high capacity of the characters for transmission to subsequent generations. However, genetic advance was high for almost all the characters except days to 50% flowering. High heritability coupled with high genetic advance was observed for several characters including green and dry fodder yield/plant which indicates predominance of additive gene action and chances of improvement of these traits through simple selection. High heritability associated with low genetic advance observed for days to 50% flowering suggested presence of non-additive gene action and improvement is difficult through direct selection in case of 50% flowering. These results are in agreement with the findings of Srivastava *et al*. (1995) [8], Singh (1999) [9], Roy *et al*. (2006) [6] and Rajbahadur *et al*. (2008) [4].

In general, genotypic correlation were higher than their corresponding phenotypic correlations indicated inherent association between various traits (Table-2). Green as well as dry fodder yield/plant was found to be positive and significantly associated with plant height, stem diameter, number of leaves/plant, leaf length and leaf breadth. Similar results were reported earlier by Choubey and Gupta (1986) [1], Srivastava *et al*. (1995) [8], Roy *et al*. (2006) [6] and Rajbahadur *et al*. (2008) [4] in forage oat.

Days to 50% flowering were positive and significantly associated with stem diameter, number of leaves/plant, leaf breadth and leaf-stem ratio. Plant height had positive and significantly association with stem diameter, leaf length and leaf breadth, whereas number of tillers/plant. Stem diameter had positive and significant association with leaf length and leaf breadth. Number of leaves/plant was found to be positive and significantly correlated with leaf-stem ratio, while leaf length had positive and significant association with leaf breadth. Leaf-stem ratio showed positive and significant correlation with dry fodder yield/plant with green fodder yield/plant.

Green and dry fodder yield/plant were taken into consideration as dependent variables and other traits as independent variables (Table – 3 & 4). Path coefficient analysis showed that plant height and stem diameter had high positive direct effect on fodder yield while both these traits had high indirect effect via plant height and stem diameter as these traits were highly associated with green and dry fodder yield. Number of tillers/plant and number of leaves/plant also had positive direct affect on both green and dry fodder yield/plant. Similar results were reported earlier by Choubey and Gupta (1986) [1], Shekhawat *et al*. (2006) [7] and Rajbahadur *et al*. (2008) [4].

It is obvious from the gist of path coefficient analysis that plant height, stem diameter, number of tillers/plant and number of leaves/plant were the component traits of both green as well as dry fodder yield. Hence, prime emphasis should be given to these four traits during selection of promising genotypes for further advancement of fodder yield in forage oat.

Table 1: Mean square, mean, range, coefficient of variation, heritability and genetic advance for fodder yield traits in oat.

Character	Mean square	Mean	Range	GCV	PCV	Heritability	Genetic advance (% of mean)
Days to 50% flowering	36.726**	106.62	98.75-113.16	3.26	3.30	97.90	6.66
Plant height (cm)	386.006**	107.41	84.16-133.41	10.54	10.58	99.33	21.65
No. of tillers/plant	6.703**	9.57	6.85-13.31	15.48	15.94	94.36	30.99
Stem diameter (mm)	1.924**	7.95	5.77-9.74	9.95	10.27	94.00	19.89
No. of leaves/plant	224.809**	52.20	36.83-78.75	16.49	16.69	97.63	33.58
Leaf length (cm)	63.726**	48.39	34.25-55.41	9.45	9.66	95.65	19.04
Leaf breadth (cm)	0.203**	2.27	1.78-2.91	11.21	11.80	90.10	21.92
Leaf: stem ratio	0.007**	0.33	0.27-0.50	14.32	14.63	95.82	28.89
Green fodder yield/plant (g)	7219.156**	266.69	175.50-375.17	18.33	18.49	98.25	37.44
Dry fodder yield/plant (g)	333.089**	53.89	34.58-79.00	19.46	19.68	97.84	39.66

** Significant at p = 0.01

GCV = Genotypic coefficient of variation, PCV = Phenotypic coefficient of variation

Table 2: Genotypic (above diagonal) and phenotypic (below diagonal) correlation coefficient among green and dry fodder yield in forage oat.

Characters	Days to 50% flowering	Plant height (cm)	No. of tillers/ plant	Stem diameter (mm)	No. of leaves/ plant	Leaf length (cm)	Leaf breadth (cm)	Leaf stem ratio	Dry fodder yield/plant (g)	Green fodder yield/plan (g)
Days to 50% flowering	-	0.2262	-0.0640	0.3394	0.2860	0.1523	0.3004	0.4226	0.1544	0.2337
Plant height (cm)	0.2346	-	-0.4265	0.6039	-0.1884	0.5708	0.6835	-0.3689	0.7588	0.6826**
No. of tillers/plant	-0.0632	-0.4173**	-	-0.4394	0.8343	-0.3186	-0.4682	0.2587	-0.1217	-0.0092
Stem diameter (mm)	0.3294*	0.5844**	-0.4159**	-	-0.0095	0.3582	0.9012	0.0768	0.63411	0.6701**
No. of	0.2802*	-0.1877	0.8245**	-0.0094	-	-0.1369	-0.0922	0.4738	0.3258	0.2987*

leaves/plant										
Leaf length (cm)	0.1508	0.5520**	-0.2957*	0.3500*	-0.1299	-	0.3698	0.0508	0.4553	0.4123**
Leaf breadth (cm)	0.2787*	0.6478**	-0.4259**	0.8422**	-0.0889	0.3472*	-	-0.208	0.5995	0.6275**
Leaf: stem ratio	0.4045**	-0.3578**	0.2459	0.0632	0.4578**	0.0381	-0.0153	-	-0.2114	-0.0647
Dry fodder yield/plant (g)	0.1500	0.7436**	-0.0948	0.6065**	0.3183*	0.4401**	0.5679**	-0.2054	-	0.9357**
Green fodder yield/plant (g)	0.2290	0.6721**	0.0124	0.6459**	0.3090*	0.4026**	0.5930**	-0.0620	0.9351**	-

*, ** Significant at P = 0.05 and P = 0.01, respectively.

Table 3: Path coefficient analysis of green fodder yield versus other traits in forage oat.

Characters	Days to 50% flowering	Plant height (cm)	No. of tillers/ plant	Stem diameter (mm)	No., of leaves/ plant	Leaf length (cm)	Leaf breadth (cm)	Leaf: stem ratio	'r' with GFY
Days to 50% flowering	-0.0932	0.1086	-0.0088	0.1810	0.1023	0.0143	-0.0277	-0.0427	0.2337
Plant height (cm)	-0.0211	0.4804	-0.0589	0.3221	-0.0674	0.0534	-0.0631	0.0373	0.6826**
No. of tillers/plant	0.0059	-0.2048	0.1383	-0.2343	0.2984	-0.0298	0.0432	-0.0261	-0.0092
Stem diameter (mm)	-0.0316	0.2901	-0.0608	0.5332	-0.0034	0.0335	-0.0832	-0.0078	0.6701**
No. of leaves/plant	-0.0266	-0.0905	0.1154	-0.0051	0.3577	-0.0128	0.0085	-0.0478	0.2987**
Leaf length (cm)	-0.0142	0.2742	-0.0441	0.1910	-0.0490	0.0935	-0.0341	-0.0051	0.4123**
Leaf breadth (cm)	-0.0280	0.3284	-0.0648	0.4806	-0.0329	0.0346	-0.0923	0.0021	0.6275**
Leaf: stem ratio	-0.0394	-0.1772	0.0358	0.0410	0.1695	0.0048	0.0019	-0.1010	-0.0647

Table 4: Path coefficient analysis of dry fodder yield versus other traits in forage oat.

Characters	Days to 50% flowering	Plant height (cm)	No. of tillers/ plant	Stem diameter (mm)	No., of leaves/ plant	Leaf length (cm)	Leaf breadth (cm)	Leaf : stem ratio	'r' with GFY
Days to 50% flowering	-0.0924	0.1356	-0.0159	0.1982	0.0329	0.0155	-0.0664	-*0.0527	0.1544
Plant height (cm)	-0.0209	0.5994	-0.1065	0.3526	-0.0216	0.0580	-0.1512	0.0461	0.7588**
No. of tillers/plant	0.0059	-0.2556	0.2497	-0.2565	0.0960	-0.0323	0.1036	-0.0323	-0.1217
Stem diameter (mm)	-0.0313	0.3620	-0.1097	0.5839	-0.0010	0.0364	-0.1993	-0.0095	0.6311**
No. of leaves/plant	-0.0264	-0.1129	0.2083	-0.0055	0.3150	-0.0139	0.0204	-0.0591	0.3258*
Leaf length (cm)	-0.0140	0.3421	-0.0795	0.2091	-0.0157	0.1016	-0.0818	-0.0063	0.4553**
Leaf breadth (cm)	-0.0277	0.4097	-0.1169	0.5262	-0.0106	0.0376	-0.2212	0.0026	0.5995**
Leaf: stem ratio	-0.0390	-0.2211	0.0645	0.0448	0.0545	0.0052	0.0046	-0.1249	-0.2114

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