Environment & Ecology 27 (4) : 1474—1477, 2009
 ISSN 0970-0420

Correlation and Path Analysis and Their Implications in Forage Oat Improvement

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Abstract

Correlation and path coefficient analyses between fodder yield traits among 50 genotypes of oat under normal and late sown conditions were studied. In general, genotypic correlation coefficients were higher in magnitude as compared to their corresponding phenotypic correlation coefficients under both the conditions. Green and dry fodder yield was positive and significantly correlated with plant height, stem diameter, number of leaves/plant, leaf length and leaf breadth at genotypic and phenotypic levels. Number of leaves/plant and plant height had high direct effect on green and dry fodder yield. However, number of leaves/plant and tillers/plant had high indirect effect under both the environments. Hence, these traits should be given due importance as major attributes in selection for higher fodder yield in oat.
Key words : Genotypic correlation coefficients, Phenotypic correlation coefficient, Path analysis, Fodder yield traits, Oat.

Correlation coefficient measures the relationship between two or more variables. The genotypic correlation coefficient provides a measure of genotypic association between different characters, while phenotypic correlation coefficients include both genotypic and environmental influences. The degree of influence of one variable on the other can be determined most accurately and precisely by path coefficient analysis (Wright 1921), which helps in partitioning the correlation coefficient into direct and indirect effects (Dewey and Lu 1959). In the present study, correlation and path coefficient analyses were carried out between fodder yield traits in oat.

Methods

The experimental material comprising 50 genotypes of oat (*Avena sativa* L.) were raised under normal and late sown conditions at the experimental farm of Forage Section, Department of Plant Breeding, CCS Haryana Agricultural University, Hisar in a randomized block design having three replications in two rows of 4 m length with recommended package of practices. The observations on five randomly competitive selected plants from each genotype under both the environments were recorded on 10 metric and two quality 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), dry fodder yield/plant (g), crude protein content (%) and *in vitro* dry matter digestibility (%). Genotypic and phenotypic correlation coefficients were computed following Robinson et al. (1951) and path coefficient analysis were worked out following Dewey and Lu (1959).

Results and Discussion

In general, genotypic correlation coefficients were of higher magnitude as compared to their corresponding phenotypic correlation coefficients under both the environments indicating strong inherent association between various traits but the phenotypic expression was reduced due to the influence of the environment (Table 1). Green and dry fodder yields were found to be positive and significantly correlated with plant height, stem diameter, number of leaves/plant, leaf length and leaf breadth under both the environments. Significant positive correlation of green fodder yield with these traits were reported by Choubey and Gupta (1986) and Roy et al. (2006). Positive and significant correlations were observed for various pairs of characters both at genotypic and phenotypic level under both the environments.

Days to 50% flowering showed positive and

Table 1. Genotypic (above diagonal) and phenotypic (below diagonal) correlation coefficients amongst green fodder yield and quality characters in oats. *, **Significant at P = 0.05 and P = 0.01, respectively.

Character	Env.	Days to 50% flowering	Plant height (cm)	No. of tillers/plant	Stem diameter (mm)	No. of leaves/plant	Leaf length (cm)
Days to 50% flowering	E_1	-	0.2662	-0.0425	-0.0031	0.0999	0.2185
	E_2	-	-0.1126	-0.0768	0.2831	0.0865	0.0250
Plant height (cm)	E_1	0.2587	-	-0.3232	0.4377	-0.1355	0.2759
	E_2	-0.1050	-	-0.4116	0.3274	-0.2922	0.6828
No. of tillers/plant	E_1	-0.0375	-0.3000*	-	-0.2858	-0.8678	-0.0809
	E_2	-0.0758	-0.4013**	-	-0.2855	0.9070	-0.5082
Stem diameter (mm)	E_1	0.0013	0.4056**	-0.2739*	-	-0.0492	0.0527
	E_2	0.2799*	0.3056*	-0.2702*	-	-0.0352	0.3201
No. of leaves/plant	E_1	0.0943	-0.1206	0.8522**	-0.0533	-	0.0165
	E_2	0.0802	-0.2891*	0.8970**	-0.0348	-	-0.3126
Leaf length (cm)	E_1	0.2149	0.2777*	-0.0763	-0.0648	0.0061	-
	E_2	0.0339	0.6533**	-0.4753**	0.2829*	-0.2915*	-
Leaf breadth (cm)	E_1	0.0483	0.5137**	-0.1506	0.7590**	0.0514	0.1311
	E_2	0.2795*	0.5368**	-0.3173*	0.7216**	-0.1092	0.4380**
Leaf : stem ratio	E_1	0.3087*	-0.4097**	0.2828*	-0.1138	0.3251*	0.1153
	E_2	0.4379**	-0.3846**	0.1284	0.1789	0.2996*	-0.0138
Dry fodder yield/plant	E_1	0.0415	0.7052**	0.1108	0.4474**	0.3128*	0.3005*
(g)	E_2	-0.0905	0.5515**	0.2232	0.3537**	0.3659**	0.2782*
Crude protein content (%)	E_1	0.2712*	-0.0798	0.0554	0.1047	0.1394	-0.2982*
	E_2	0.1317	-0.1432	0.1245	0.3533**	0.2285	-0.1671
In vitro dry matter	E_1	0.4435**	-0.0541	0.2061	0.1509	0.3410*	-0.0466
digestibility (%)	E_2	0.1134	0.0692	-0.0877	0.2760*	-0.0402	0.1818
Green fodder yield/plant (g)	E_1	0.0343	0.5375**	0.2645	0.4918**	0.5114**	0.3045*
	E_2	0.0116	0.5178**	0.2752*	0.3840**	0.4298**	0.2916*

Table 1. Continued.

Character	Env.	Leaf breadth (cm)	Leaf : stem ratio	Dry fodder yield/plant (g)	Crude protein content (%)	*In vitro* dry matter digestibility (%)	Green fodder yield/plant (g)
Days to 50% flowering	E_1	0.0579	0.3371	0.0443	0.2960	-0.4999	0.0372
	E_2	0.2982	0.4533	-0.0926	-0.1674	0.1669	0.0146
Plant height (cm)	E_1	0.5533	-0.4523	0.7215	-0.0832	-0.0672	0.5481**
	E_2	0.5774	-0.3928	0.5756	-0.1533	0.0852	0.5345**
No. of tillers/plant	E_1	-0.1897	0.3352	0.0680	0.0555	0.2437	0.2315
	E_2	-0.3437	0.1342	0.1939	0.1609	-0.0768	0.2539
Stem diameter (mm)	E_1	0.8619	-0.1435	0.4870	0.1175	0.1780	0.5367**
	E_2	0.8184	0.1975	0.3853	0.3788	0.3089	0.4161**
No. of leaves/plant	E_1	0.0517	0.3781	0.2832	0.1427	0.3725	0.4902**
	E_2	-0.1105	0.3088	0.3506	0.2608	-0.0349	0.4173**
Leaf length (cm)	E_1	0.1451	0.1319	0.3223	-0.3203	-0.0446	0.3314*
	E_2	0.4904	-0.0171	0.2802	-0.1680	0.2402	0.3082*
Leaf breadth (cm)	E_1	-	-0.0273	0.6097	0.1386	0.2121	0.6460**
	E_2	-	-0.0179	0.5361	0.2584	0.3066	0.4923**
Leaf : stem ratio	E_1	-0.0151	-	-0.3795	0.1727	0.3410	-0.2107
	E_2	-0.0071	-	-0.2663	0.2735	0.3452	-0.1437
Dry fodder yield/plant (g)	E_1	0.5591**	-0.3531**	-	-0.0970	0.0927	0.8930**
	E_2	0.4818**	-0.2533	-	0.2087	0.0800	0.9475**
Crude protein content (%)	E_1	-0.1479	0.1634	-0.0803	-	0.6346	0.0579
	E_2	0.2285	0.2881*	0.1696	-	0.3988	0.2387
In vitro dry matter	E_1	0.1909	0.2784*	0.0888	0.6590**	-	0.3061*
digestibility (%)	E_2	0.2819*	0.2933*	0.0421	0.4987**	-	0.1482
Green fodder yield plant (g)	E_1	0.5935**	0.2002	0.8961**	0.0600	0.2750*	-
	E_2	0.4482**	-0.1369	0.9452**	0.2053	0.1094	-

Table 2. Path coefficient analysis of green fodder yield versus other traits in oat.

Character	Env.	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	E_1	**0.0020**	0.0250	0.0071	0.0001	0.0776	0.0378	0.0284	-0.1406	0.0372
	E_2	**0.0311**	-0.0700	-0.0006	0.0802	0.0540	-0.0021	-0.0024	-0.0757	0.0146
Plant height (cm)	E_1	0.0005	**0.0934**	0.0541	-0.0025	-0.1053	0.0477	0.2715	0.1886	0.5481**
	E_2	-0.0035	**0.6220**	-0.0031	0.0961	-0.1826	-0.0552	-0.0047	0.0656	0.5345**
No. of tillers/plant	E_1	-0.0001	-0.0302	**-0.1674**	0.0017	0.6744	-0.0140	-0.0930	-0.1398	0.2315
	E_2	-0.0023	-0.2560	**0.0075**	-0.0838	0.5670	0.0411	0.0028	-0.0224	0.2539
Stem diameter (mm)	E_1	-0.0001	0.0409	0.0479	**-0.0058**	-0.0382	0.0091	0.4230	0.0599	0.5367**
	E_2	0.0085	0.2036	-0.0022	**0.2936**	-0.0219	-0.0259	-0.0066	-0.0330	0.4161**
No. of leaves/plant	E_1	0.0002	-0.0127	-0.1453	0.0003	**0.7771**	0.0029	0.0254	-0.1577	0.4902**
	E_2	0.0027	-0.1817	0.0068	-0.0103	**0.6252**	0.0253	0.0009	-0.0516	0.4173**
Leaf length (cm)	E_1	0.0004	0.0858	0.0135	-0.0003	0.0128	**0.2029**	0.0712	-0.0550	0.3314*
	E_2	0.0008	0.4247	-0.0038	0.0940	-0.1266	**-0.0808**	-0.0039	0.0038	0.3082*
Leaf. breadth (cm)	E_1	0.0001	0.0517	0.0318	-0.0050	0.0401	0.0251	**0.4908**	0.0114	0.6460**
	E_2	0.0093	0.3592	-0.0026	0.2403	-0.0691	-0.0396	**-0.0081**	0.0030	0.4923**
Leaf : stem ratio	E_1	0.0007	-0.0423	-0.0561	0.0008	0.2939	0.0228	-0.0134	**-0.4170**	-0.2107
	E_2	0.0141	-0.2443	0.0010	0.0580	0.1930	0.0014	0.0001	**-0.1669**	-0.1437

significant association with leaf- stem ratio under both the conditions, and with crude protein content and *in vitro* dry matter digestibility under normal sown condition, and with stem diameter and leaf breadth under late sown condition. Plant height had positive and significant association with stem diameter, leaf length and leaf breadth under both the environments. Number of tillers/plant was positive and significantly correlated with number of leaves/plant. Stem diameter had positive and significant correlation with leaf breadth under both conditions and with leaf length, crude protein content and *in vitro* dry matter digestibility under late sown conditions. Number of leaves/plant had positive and significant association with leaf-stem ratio under both the conditions and with *in vitro* dry matter digestibility under normal sown condition. Leaf length showed positive and significant association with leaf breadth and leaf breadth with *in vitro* dry matter digestibility under late sown condition only. Leaf-stem ratio had posi-

Table 3. Path coefficient analysis of dry fodder yield versus other traits in oat.

Character	Env.	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 DFY
Days to 50% flowering	E_1	**-0.0255**	0.0885	0.0016	0.0002	0.0494	0.0491	0.0241	-0.1430	0.0443
	E_2	**-0.1220**	-0.0559	0.0218	0.0120	0.0717	-0.0035	0.0918	-0.1086	-0.0926
Plant height (cm)	E_1	-0.0068	**0.3324**	0.0122	-0.0336	-0.0670	0.0620	0.2305	0.1919	0.7215**
	E_2	0.0137	**0.4965**	0.1171	0.0145	-0.2425	-0.0957	0.1778	0.0942	0.5756**
No. of tillers/plant	E_1	0.0011	-0.1074	**-0.0378**	0.0220	0.4296	-0.0182	-0.0790	-0.1422	0.0680
	E_2	0.0094	-0.2043	**-0.2845**	-0.0126	0.7528	0.0712	-0.1058	-0.0321	0.1939
Stem diameter (mm)	E_1	0.0001	0.1455	0.0108	**-0.0768**	-0.0243	0.0118	0.3590	0.0609	0.4870**
	E_2	-0.0333	0.1626	0.0812	**0.0442**	-0.0292	-0.0448	0.2521	-0.0473	0.3853**
No. of leaves/plant	E_1	-0.0025	-0.0450	-0.0328	0.0038	**0.4950**	0.0037	0.0215	-0.1604	0.2832*
	E_2	-0.0105	-0.1451	-0.2580	-0.0015	**0.8300**	0.0438	-0.0340	-0.0740	0.3506*
Leaf length (cm)	E_1	-0.0056	0.0917	0.0031	-0.0040	0.0082	**0.2245**	0.0604	-0.0559	0.3223*
	E_2	-0.0030	0.3400	0.1500	0.0271	-0.2490	**-0.1400**	0.1510	0.0041	0.2802*
Leaf breadth (cm)	E_1	-0.0015	0.1839	0.0072	-0.0662	0.0256	0.0326	**0.4166**	0.0116	0.6097**
	E_2	-0.0364	0.2867	0.0978	0.0361	-0.0916	-0.0687	**0.3080**	0.0043	0.5361**
Leaf : stem ratio	E_1	-0.0086	-0.1503	-0.0127	0.0110	0.1872	0.0296	-0.0114	**-0.4243**	-0.3795
	E_2	-0.0553	-0.1950	-0.0381	0.0087	0.2563	0.0024	-0.0055	**-0.2397**	-0.2663

tive and significant association with crude protein content in late sown condition and with *in vitro* dry matter digestibility in both the conditions. Crude protein content had positive and significant correlation with *in vitro* dry matter digestibility under both the environments.

Green and dry fodder yield is of prime importance and is considered as dependent variables and other component traits as independent variables. Path coefficient analysis provide a better understanding of the cause and effect relationships between different pairs of characters and further dissecting the association into direct and indirect influences (Tables 2 and 3). Number of leaves/plant and plant height exhibited considerable direct effect on green and dry fodder yield, whereas indirect effect of number of tillers/plant was high via number of leaves/plant under both the environments. These results are in agreement with the findings of Choubey and Gupta (1986) and Shekhawat et al. (2006). Indirect effect of stem diameter and plant height was also high and positive when compared with the indirect effect of other variables under both the environments. As both traits were positive and significantly associated with green and dry fodder yield and also had high positive indirect effect on fodder yield through each other.

It is concluded that plant height, number of tiller/plant, stem diameter, number of of leaves/plant, leaf breadth and length will be more useful in subsequent generations than that of any other yield components. Therefore, these traits should be given due importance in selection while breeding for higher fodder yield in oat.

References

Choubey R. N. and S. K. Gupta. 1986. Correlation and path analysis is forage oat. *Indian J. Agric. Sci.* 56 : 674—677.

Dewey D. R. and K. H. Lu. 1959. A correlation and path coefficient analysis of components of crested wheat grass seed production. *Agron. J.* 51 : 515—518.

Robinson H. F., R. E. Comstock and P. H. Harvey. 1951. Genotypic and phenotypic correlations in corn and their implications in selection. *Agron. J.* 43 : 282—287.

Roy S., D. K. De and P. Bandopadhyay. 2006. Correlation and path coefficient analysis of forage yield components in oat (*Avena sativa* L.). *Forage Res.* 32 : 51—55.

Shekhawat S. S., D. K. Garg and J. S. Verma. 2006. Character association and variability study in oats (*Avena sativa* L.) for green fodder yield and related traits. *Forage Res.* 32 : 163—168.

Wright S. 1921. Correlation and causation. *J. Agric. Res.* 20 : 557—585.