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CORRELATION AND PATH COEFFICIENT ANALYSIS OF ADVANCE GENERATION OF MUTANT OATS (*AVENA SATIVA* L.) LINES

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SUMMARY

The present investigation was carried out to evaluate 118 mutant oats including three checks JO-1, JO 03-91 and Kent for association among traits and to judge the direct and indirect effect of various yield and its attributing traits in pooled of M4 and M5 generation. The study were conducted during R*abi* season 2016-17 and R*abi* 2017-18 under All India Coordinated Research Project on Forage Crops, Seed Breeding Farm, JNKVV, Jabalpur. Data obtained for correlation and path studies suggested the most important traits observed among the mutant lines were dry matter yield per plant per day, thousand seed weight, plant height hence, direct selection may be effective for the improvement of these characters because these traits had highly significant and positive correlation along with direct positive effect with dry matter yield per plant. Whereas, the characters crude protein yield per plant, crude protein yield per plant per day and panicle weight were also found important as, indirect selection through such traits may be effective in yield improvement as the correlation is mainly due to indirect effects of the character through other component trait. Moreover, these traits can be considered for formulating plant ideotype and selection based on these characters shall be rewarding for higher yield.

Key words : Correlation, yield, ideotype, selection, crude protein

Oat (*Avena sativa*), sometimes called the common oat, is a species of domesticated cereal grass (family Poaceae) grown primarily for its edible starchy grains. Oats are widely cultivated in the temperate regions of the world and are second only to rye in their ability to survive in poor soils. Although oats are used chiefly as livestock feed, some are processed for human consumption, especially as breakfast foods. The plants provide good hay and, under proper conditions, furnish excellent grazing. The total area, production and productivity during 2015 were about 9.58 million hectares, 22.60 million metric tons and 2.36 metric tons per hectare, respectively in the world (USDA, 2016).

Development of high yielding varieties of oats for grain and forage yield requires the implication of crop improvement to stable the superior lines or initiating a breeding programme based on the yield components. Yield is a complex character which is contributed by a large number of component traits. Therefore, to determine the relative importance of the component characters and to initiate an effective selection programme, correlation studies are practiced. The traits contributing significantly towards yield could be identified and used as base for alternative selection criteria for forage yield improvement. Simple correlation coefficients provide association (positive and negative) between characters but it does not give causal basis of such associations. Path analysis provides the information on direct and indirect effects of various independent components on the dependent character. All these traits are affected by genetic and environmental factors (Achleitner *et al*., 2008). Thus in present study path coefficient analysis was done considering dry fodder yield as a dependent character Poonia *et al.* (2017).

MATERIALS AND METHODS

The present investigation was carried out during *Rabi* season 2016-17 and *Rabi* 2017-18 under All India Coordinated Research Project on Forage Crops, Seed Breeding Farm, JNKVV, Jabalpur. A total of 118 mutant lines including three checks were evaluated over pooled of in M_4 and M_5 generation for genetic variability parameters. The observations were recorded for yield and its component characters *viz*., days to flower initiation, days to 50% flowering, days to maturity, plant height, number of tillers per plant, number of leaves per tiller, panicle length, flag leaf

length, internode length, flag leaf width, peduncle length, number of spikelets per panicle, number of florets per panicle, panicle weight, thousand seed weight, dry matter yield per plant per day, crude protein yield per plant, crude protein yield per plant per day, dry matter yield per plant were studied. Correlation coefficient at phenotypic level was calculated from the variance and covariance according to Johnson *et al*. (1955). Direct and indirect effect of various contributing traits towards green fodder yield and dry matter yield was calculated using the path coefficients analysis (Dewey and Lu, 1959).

RESULTS AND DISCUSSION

Correlation Analysis

Correlation studies are of considerable importance in breeding programmes. Galton (1988) was first to suggest the use of correlation index to describe the degree of association between two variables. The degrees of association also affect the effectiveness of selection process. In the present study the correlation has been studied that are presented in Table 1.

In the present findings the characters *viz*., plant height (0.2380), number of leaves per tiller (0.1587), panicle weight (0.1547), thousand seed weight (0.1192), dry matter yield per plant per day(0.4141), crude protein yield per plant (0.2906), crude protein yield per plant per day (0.2753) shared strong positive correlation with dry matter yield per plant at phenotypic levels.

The results are in agreement with the findings of Choubey *et al.* (2001) for plant height and dry matter yield per plant per day that were significantly and positively correlated with dry matter yield per plant and by Kumar *et al* (2004) for plant height and dry matter yield per plant per day.

Plant height was observed to have positive correlation with panicle length, flag leaf width, panicle weight thousand seed weight, dry matter yield per plant, number of tillers per plant, peduncle length, number of leaves per tiller, number of spikelet per panicle and crude protein yield per plant. Number of leaves per tiller had positive association with flag leaf length, dry matter yield per plant and internode length. Flag leaf width observed to have positive correlation with days to flower initiation, 50 percent flowering, plant height.

Panicle weight had positive correlation with plant height, number of spikelet per panicle, number of florets per panicle, thousand seed weight, dry matter yield per plant. Thousand seed weight had positive correlation with plant height, panicle weight, dry matter yield per plant. Dry matter yield per plant per day had positive association with crude protein yield per plant, crude protein yield per plant per day and dry matter yield per plant. Crude protein yield per plant had positive correlation with dry matter yield per plant per day, crude protein yield per plant per day and dry matter yield per plant. Crude protein yield per plant per day had shown highly significant positive correlation with dry matter yield per plant per day, crude protein yield per plant, dry matter yield per plant. There was no significant negative correlation was observed for any traits with dry matter yield per plant. These results are in accordance with the findings of Kumar *et al.* (2004) for Plant height with number of leaves per plant, dry matter yield per plant. Similar results for one or more characters were reported by many researchers (Ahmed *et al.,* 2013, Vaisi *et al.,* 2013; Krishna *et al.,* 2014) for one or more character

Path Analysis

Path coefficient analysis expressed as phenotypic, genotypic and environmental paths.It is standardized partial regression coefficients, which splits the correlation coefficients into the measures of direct and indirect effects of a set of independent variable. Path coefficient analysis was carried out using genotypic correlation coefficient and dry matter yield per plant as dependent variable in order to observe the causal factor for producing dry matter yield.

The genotypic path coefficient analysis of different characters using dry matter yield per plant as a dependent variable revealed that very high positive direct effect on dry matter yield was exerted by dry matter yield per plant per day (1.643) followed by thousand seed weight (1.587), number of florets per panicle (1.411), panicle length (1.246), days to 50 percent flowering (0.906). High positive direct effect was exerted by plant height (0.388), crude protein yield per plant per day (0.3820) and moderate positive direct effect via days to flower initiation (0.209), days to maturity (0.103) whereas, trait flag leaf length (0.059) and number of spikelets per panicle (0.065) showed negligible positive direct effect.

On the other hand, very high negative direct effect was shown by panicle weight (-1.538), peduncle length (-1.537), flag leaf width (-0.688), internode

TABLE 1
Correlation coefficient analysis for yield and its attributing traits pooled

Character	D50F	DM	PH	NTP	NLT	PCL	FLL	INL	FLW	PDL	NSP	NFP	PW	TSW	DMYD	CPY	CPYD	DMY
DFI	0.6238**	0.4768**	0.2622**	0.0074	0.0612	0.0947	-0.0708	-0.0067	0.2296**	0.0423	0.0304	-0.0206	0.0584	0.0488	-0.4091**	-0.0505	-0.3296**	0.0573
D50F		0.4041**	0.1627**	-0.0071	-0.0057	0.1050*	-0.0975	-0.0355	0.2759**	0.0833	0.0515	0.0181	0.0131	-0.0404	-0.4004**	-0.0349	-0.2763**	-0.0286
DM			0.2580**	-0.0090	0.1147*	0.1305*	-0.0460	0.0910	0.1701**	0.0928	0.0176	-0.0243	0.1038	0.1697**	-0.4212**	-0.0012	-0.2830**	0.0759
PH				0.1831**	0.1796**	0.1565**	-0.0826	0.0326	0.1984**	0.2054**	0.1471**	0.0609	0.2533**	0.2222**	-0.0545	0.1277*	-0.1133*	0.2380**
NTP					0.2153**	-0.1270*	0.1253*	-0.1065*	0.0238	-0.0088	0.0723	0.0496	-0.0533	-0.0545	0.1220*	0.0553	-0.0179	0.0916
NLT						-0.0560	0.3872**	0.1345*	0.0946	0.0130	0.0423	0.0291	0.0533	0.0842	0.0100	0.0318	-0.0446	0.1587**
PCL							-0.2030**	0.2087**	0.0999	0.4735**	-0.0241	-0.0465	0.0608	0.1954**	-0.0957	-0.0471	-0.1428**	0.0537
FLL								0.0163	0.0685	-0.1483**	-0.0022	-0.0031	-0.1922**	-0.0999	0.1904**	0.1000	0.0861	0.0510
INL									0.0489	0.0556	-0.0553	-0.0331	-0.0091	-0.0032	-0.0585	-0.0130	-0.0569	-0.0156
FLW										-0.0121	0.1011	0.0485	0.0470	0.0086	-0.1101*	0.0835	-0.0738	0.0835
PDL											-0.0300	-0.0559	0.1011	0.1579**	-0.0585	0.0148	-0.0834	0.0452
NSP												0.8817**	0.6102**	-0.1154*	0.0642	0.1100*	-0.0190	0.0833
NFP												0.6596**	-0.0947	0.0777	0.1212*	0.0046	0.0554	
PW														0.2540**	-0.0125	0.0116	0.0127	0.1547**
TSW															-0.0033	0.0007	0.0234	0.1192*
DMYD																0.4056**	0.6747**	0.4141**
CPY																	0.3385**	0.2906**
CPYD																		0.2753**

Note: DFI-Days to flower initiation; D50F %- Days to 50% flowering; DM- Days to maturity; PH- Plant height; NTP- Number of tillers per plant; NLT- Number of leaves per tiller; PCL- Panicle length; FLL- Flag leaf length; INL- Internode length; FLW- Flag leaf width; PDL-Peduncle length; NSP- Number of spikelets per panicle; NFP- Number of florets per panicle; PW- Panicle weight; TSW- Thousand seed weight; DMYD- Dry matter yield per plant per day; CPY- Crude protein yield per plant; CPYD- Crude protein yield per plant per day; DMY- Dry matter yield per plant.

TABLE 2
Path analysis for yield and its attributing traits pooled

Character	DFI	D50F	DM	PH	NTP	NLT	PCL	FLL	INL	FLW	PDL	NSP	NFP	PW	TSW	DMYD	CPY	CPYD	DMY
DFI	**0.209**	1.203	0.180	0.209	-0.018	-0.053	0.117	-0.006	-0.047	-0.293	-0.341	0.013	0.082	-0.123	-0.067	-1.144	0.005	0.187	0.114
D50F	0.277	**0.906**	0.203	0.201	0.001	-0.018	0.265	-0.005	-0.030	-0.343	-0.282	0.015	0.127	-0.270	0.165	-1.278	0.002	0.245	0.181
DM	0.366	1.793	**0.103**	0.253	0.018	-0.039	0.297	-0.019	-0.036	-0.390	-0.594	0.004	-0.028	-0.165	0.034	-1.814	-0.002	0.310	0.310
PH	0.112	0.469	0.067	**0.388**	-0.044	-0.040	0.196	-0.017	-0.078	-0.225	-0.308	0.011	0.088	-0.442	-0.453	-0.279	0.006	0.071	0.429
NTP	0.019	-0.003	-0.009	0.086	**-0.197**	-0.065	-0.197	0.008	-0.132	0.022	0.190	0.014	0.282	0.147	-0.319	0.254	0.005	0.023	0.127
NLT	0.031	0.045	0.011	0.043	-0.036	**-0.361**	-0.174	0.031	0.003	-0.159	0.573	-0.012	-0.276	0.389	0.133	-0.074	-0.008	0.034	0.193
PCL	0.020	0.193	0.024	0.061	0.031	0.051	**1.246**	-0.020	0.138	-0.072	-1.582	-0.006	-0.225	-0.138	0.496	-0.321	-0.007	0.080	-0.032
FLL	-0.021	-0.071	-0.033	-0.111	-0.026	-0.189	0.414	**0.059**	-0.079	-0.056	0.617	-0.004	-0.065	0.604	-0.508	0.354	0.006	-0.040	0.024
INL	-0.016	-0.043	-0.006	-0.049	0.042	-0.002	0.278	-0.008	**-0.617**	-0.069	-0.232	-0.013	-0.244	0.091	-0.325	-0.133	-0.009	0.033	-0.087
FLW	0.089	0.452	0.058	0.127	0.006	-0.083	0.130	0.005	0.062	**-0.688**	0.026	0.013	0.101	-0.145	0.137	-0.219	0.002	0.051	0.121
PDL	0.046	0.166	0.040	0.078	0.024	0.135	1.283	-0.024	0.093	0.012	**-1.537**	-0.003	-0.209	-0.280	0.315	-0.306	-0.007	0.079	-0.094
NSP	0.042	0.209	0.006	0.065	-0.043	0.066	-0.112	-0.004	-0.118	-0.138	0.081	**0.065**	1.291	-0.761	-0.566	0.031	-0.003	0.034	0.145
NFP	0.012	0.082	-0.002	0.024	-0.039	0.071	-0.198	-0.003	-0.107	-0.049	0.228	0.060	**1.411**	-0.979	-0.544	0.092	-0.007	0.016	0.066
PW	0.017	0.159	0.011	0.111	0.019	0.091	0.112	-0.023	-0.037	-0.065	-0.279	0.032	0.898	**-1.538**	0.776	-0.096	-0.002	0.007	0.194
TSW	-0.009	0.094	0.002	0.111	0.040	-0.030	0.389	-0.019	-0.127	-0.060	-0.305	-0.023	-0.484	-0.752	**1.587**	-0.199	-0.009	-0.022	0.184
DMYD	-0.145	-0.705	-0.113	-0.066	-0.030	0.016	-0.244	0.013	-0.050	0.092	0.286	0.001	0.079	0.089	-0.193	**1.643**	0.040	-0.310	0.405
CPY	-0.031	-0.044	0.005	-0.063	0.025	-0.077	0.235	-0.010	0.154	0.030	-0.298	0.006	0.253	-0.078	0.401	-1.846	**-0.036**	0.383	-0.990
CPYD	-0.102	-0.580	-0.083	-0.072	0.012	0.032	-0.259	0.006	-0.053	0.092	0.319	-0.006	-0.057	0.029	0.091	1.333	0.036	**-0.382**	0.355

length (-0.617). High negative direct effect on dry matter yield per plant was exhibited by crude protein yield per plant per day (-0.382), number of leaves per tiller (-0.361) and low negative direct effect via number of tillers per plant (-0.197) whereas, the trait crude protein yield per plant (-0.036) showed negligible negative direct effect.

Choubey *et al.* (2001) revealed that number of tillers showed high positive direct effect on green fodder yield. Bukhari *et al.* (2009) indicated same from the path analysis that traits like days to 50% flowering, number of tillers, dry fodder yield, leaf area index, leaf stem ratio plays a major role for improvement of yield potential of fodder oats. Similar results for one or more characters were reported by Vaisi *et al.* (2013) and Krishna *et al.* (2014).

Data obtained for correlation and path studies suggested the most important traits observed among the mutant lines were dry matter yield per plant per day, thousand seed weight, plant height direct selection may be effective for the improvement of these characters because these traits shows highly significant and positive correlation along with direct positive effect with dry matter yield per plant whereas, the characters crude protein yield per plant and crude protein yield per plant per day, panicle weight and number of florets per panicle hence, were also found important as, indirect selection through such traits may be effective in yield improvement as the correlation is mainly due to indirect effects of the character through other component trait.

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