Forage Res., **43** (3) : pp. 239-243 (2017) **http://forageresearch.in**

VARIABILITY, CHARACTER ASSOCIATION AND PATH COEFFICIENT ANALYSIS IN FODDER OAT FOR YIELD AND QUALITY TRAITS

ATMAN POONIA, D. S. PHOGAT, S. K. PAHUJA, AXAY BHUKER AND R. S. KHATRI

Department of Genetics and Plant Breeding,
CCS Haryana Agricultural University,
Hisar-125 004 (Haryana), India
**(e-mail : dsphogatccshau@gmail.com)*

(Received : 26 September 2017; Accepted : 19 December 2017)

SUMMARY

The present investigation was carried out in Forage Section Department of Genetics &Plant Breeding, Chaudhary Charan Singh Haryana Agricultural University, Hisar during *rabi* 2015-16 to estimate the magnitude of correlation among yield and quality traits and their effects. High variability was found in the present study material for dry matter yield it ranged from 30g (HFO-872) to 820g (UPO-212). The genotypes with highest value of dry matter yield were Algerian, OL-125 and JHO-99-1. Positive and significant correlations of dry matter yield per meter row length were recorded for plant height, seed yield per meter row length, green fodder yield per meter row length, flag leaf length, inter-node length, axis length, leaf length and germination %. Path coefficient analysis revealed that characters viz. green fodder yield, number of tillers per plant, plant height and seed yield per meter row length had positive and direct effects on dry matter yield per meter row length, while the characters number of days to 50% flowering, peduncle length, axis length, number of spikelets/panicle, and number of leaves per plant showed direct negative effects. Hence, it would be rewarding to lay stress on characters viz. green fodder yield, number of tillers per plant, plant height and seed yield per meter row length for the improvement of dry matter yield.

Key Words : Variability, correlation, *Avena sativa* L., selection, fodder

Oat is considered to be a potential source of low cost protein with good nutritional value. Oat has a unique protein composition along with high protein content of 11–15 %. Cereal proteins have been classified into four types according to their solubility as follows: albumins (water soluble), globulins (salt water soluble), prolamins (soluble in dilute alcohol solution) and glutelins (soluble in acids or bases). Oat protein not only differs in the structural properties but also differs in distribution of protein fraction in comparison to other cereal grains. Other cereals such as wheat and barley have characteristic protein matrix which lacks in oat. In wheat and some other cereals, the storage protein is insoluble in salt solutions, while in oats, a large portion of salt water soluble globulins also belong to the storage proteins of the endosperm (Klose *et al.* 2009).

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 practised. The traits contributing significantly towards yield could be identified and used as base for alternative selection criteria for forage yield improvement. In forage oat, dry fodder yield is an important character on which animal performance is dependent. Hence, dry fodder yield per meter row length was taken as dependent character for correlation studies in this investigation.

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. Both green and dry fodder yield are equally important if we consider morphological characters, however, in case of animal performance and their body maintenance, dry fodder yield is more important. Thus in present study path coefficient analysis was done considering dry fodder yield as a dependent character.

MATERIALS AND METHODS

The field experiment was conducted at the Forage Research Area, Department of Genetics & Plant Breeding, Chaudhary Charan Singh Haryana

Agricultural University, Hisar during *rabi* 2015-16.The experimental material comprising of 92 oat genotypes was evaluated for 24 characters following the recommended agronomical package of practices in a Randomized Block Design with three replications keeping row to row distance 45 cm and plant to plant distance at10cm. The observations were recorded under prevailing weather conditions given in (Table 1 and Fig. 1) taken from Department of Agricultural Meteorology C.C.S. Haryana Agricultural University, Hisar. The observations were recorded on five randomly selected plants of each genotype in each replication for the 16 morphological characters *viz*., plant height (cm), number of days to 50% flowering, number of days to maturity, number of tillers/plant, number of spikelets/panicle, flag leaf length (cm), internode length (cm) peduncle length (cm), axis length (cm), seed yield (g), 100-seed weight (g), leaf length(cm), leaf width (cm), green fodder yield/meter row length (kg), dry matter yield/meter row length (kg) and number of leaves/plant and six seed quality parameters viz. germination (%), seedling length (cm), seedling dry weight (mg), seed vigour index I, seed vigour index II and electrical conductivity (mS/cm/seed) and quality characters such as forage crude protein (%) and seed crude Protein (%).

RESULTS AND DISCUSSION

Variability and Mean Performance

High variability was found in the present study material for dry matter yield (Table 1) it ranged from 30g (HFO-872) to 820g (UPO-212). The genotypes with highest value of dry matter yield were ALGERIAN, OL-125, JHO-99-1, HFO-879, HFO-502, HFO-58, HFO-876, HFO-409, HFO-839, HFO-836, HFO-884, HFO-852, HFO-845, HFO-883, HFO-610, HFO-706, HFO-904, HFO-924 and HFO-912. Similar findings were also reported by Pundir *et al.* (2008) and Sangwan *et al.* (2012).

Genotypic and Phenotypic Correlation Coefficients

Analysis of variance showed all the characters were highly significant, thereby indicating that that there was enough variability among the genotypes for characters studied. Results indicated that many yield contributing traits viz., plant height, leaf length and dry matter yield had positive and highly significant correlation at genotypic as well as phenotypic level with green fodder yield (Table 2 and Fig. 2) and the selection based on these characters will result in improving the dry matter yield in oat. Further perusal of the data revealed that none of the traits under study

TABLE 1
List of ninety different genotypes of oat used in the study

S. No.	Genotypes	Source	DMY	S. No.	Genotypes	Source	DMY	S. No.	Genotypes	Source	DMY
1	JO-1	JNKVV, Jabalpur	357	31	HFO-502	CCSHAU, Hisar	187	61	HFO-845	CCSHAU,Hisar	213
2	ALGERIAN	ALGERIA	304	32	HFO-58	CCSHAU, Hisar	163	62	HFO-883	CCSHAU,Hisar	218
3	HFO-267	CCSHAU, Hisar	128	33	HFO-78	CCSHAU, Hisar	123	63	HFO-831	CCSHAU,Hisar	154
4	OL-125	PAU, Ludhiana	199	34	HFO-60	CCSHAU, Hisar	193	64	HFO-114	CCSHAU,Hisar	193
5	0L-10	PAU, Ludhiana	169	35	HFO-603	CCSHAU, Hisar	185	65	HFO-832	CCSHAU,Hisar	204
6	PLP-1	CSKHPAU, Palampur	163	36	HFO-878	CCSHAU, Hisar	152	66	HFO-603	CCSHAU,Hisar	256
7	JHO-2006-4	IGFRI, Jhansi	210	37	HFO-874	CCSHAU, Hisar	122	67	HFO-605	CCSHAU,Hisar	195
8	SABZAR	SKAUST, Shrinagar	222	38	HFO-875	CCSHAU, Hisar	105	68	HFO-611	CCSHAU,Hisar	253
9	DUNAV	BULGARIA	175	39	HFO-872	CCSHAU, Hisar	108	69	HFO-704	CCSHAU,Hisar	145
10	JHO-851	IGFRI, Jhansi	228	40	HFO-498	CCSHAU, Hisar	146	70	HFO-715	CCSHAU,Hisar	238
11	UPO-94	GBPUAT, Pantnagar	181	41	HFO-867	CCSHAU, Hisar	181	71	HFO-610	CCSHAU,Hisar	181
12	JHO-822	IGFRI, Jhansi	193	42	HFO-508	CCSHAU, Hisar	210	72	HFO-706	CCSHAU,Hisar	179
13	SKO-90	SKAUST, Shrinagar	128	43	Kalojan	Bulgaria	195	73	HFO-703	CCSHAU,Hisar	158
14	JHO-99-1	IGFRI, Jhansi	228	44	HFO-409	CCSHAU, Hisar	158	74	HFO-575	CCSHAU,Hisar	153
15	FOS-1/29	CCSHAU, Hisar	240	45	HFO-414	CCSHAU, Hisar	140	75	HFO-614	CCSHAU,Hisar	200
16	DULO	Bulgaria	316	46	HFO-523	CCSHAU, Hisar	144	76	HFO-707	CCSHAU,Hisar	168
17	UPO-212	GBPUAT, Pantnagar	263	47	HFO-433	CCSHAU, Hisar	160	77	HFO-905	CCSHAU,Hisar	175
18	OS-6	CCSHAU, Hisar	193	48	HFO-885	CCSHAU, Hisar	142	78	HFO-908	CCSHAU,Hisar	213
19	JHO-2006-2	IGFRI, Jhansi	140	49	HFO-896	CCSHAU, Hisar	171	79	HFO-914	CCSHAU,Hisar	218
20	KENT	AUSTRALIA	187	50	HFO-839	CCSHAU, Hisar	105	80	HFO-909	CCSHAU,Hisar	206
21	HFO-505	CCSHAU, Hisar	128	51	HFO-836	CCSHAU, Hisar	121	81	HFO-904	CCSHAU,Hisar	204
22	HFO-975	CCSHAU, Hisar	187	52	HFO-863	CCSHAU, Hisar	125	82	HFO-910	CCSHAU,Hisar	249
23	HFO-69	CCSHAU, Hisar	107	53	HFO-884	CCSHAU, Hisar	137	83	HFO-913	CCSHAU,Hisar	227
24	HFO-876	CCSHAU, Hisar	210	54	HFO-841	CCSHAU, Hisar	122	84	HFO-921	CCSHAU,Hisar	115
25	HFO-305	CCSHAU, Hisar	205	55	HFO-851	CCSHAU, Hisar	156	85	HFO-924	CCSHAU,Hisar	258
26	HFO-504	CCSHAU, Hisar	240	56	HFO-880	CCSHAU, Hisar	122	86	HFO-919	CCSHAU,Hisar	200
27	HFO-864	CCSHAU, Hisar	187	57	HFO-893	CCSHAU, Hisar	121	87	HFO-906	CCSHAU,Hisar	154
28	HFO-865	CCSHAU, Hisar	169	58	HFO-852	CCSHAU, Hisar	110	88	HFO-912	CCSHAU,Hisar	303
29	HFO-877	CCSHAU, Hisar	216	59	HFO-870	CCSHAU, Hisar	140	89	HFO-902	CCSHAU,Hisar	194
30	HFO-879	CCSHAU, Hisar	287	60	HFO-862	CCSHAU, Hisar	130	90	HFO-920	CCSHAU,Hisar	200

TABLE 2
Phenotypic (above diagonal) and genotypic (below diagonal) correlation coefficients among 24 characters of 92 genotypes of oat

	PH	DF	DM	FLL	IL	TPL	PL	AL	NOS	SY	SI	LL	LW	GFY	DMY	NOL	CPg	CPf	GP	SL	SDW	SVI	SVII	EC
PH	1.00	0.071	-0.074	0.181**	0.055	-0.081	-0.09	0.079	0.129*	0.227**	0.098	0.066	-0.032	0.452**	0.391**	-0.078	-0.062	-0.001	0.099	-0.027	-0.058	0.021	-0.035	-0.081
DF	0.128*	1.00	0.099	-0.079	-0.162**	0.023	-0.272**	-0.051	-0.175**	-0.014	-0.227**	-0.08	0.157**	0.137*	0.044	-0.116	-0.129*	-0.037	0.003	0.03	0.005	0.022	0.004	0.162**
DM	-0.098	0.124*	1.00	-0.042	-0.121*	0.340**	-0.155**	-0.145*	0.045	-0.049	-0.133*	-0.029	0.034	-0.118	-0.032	0.223**	-0.04	-0.206**	-0.251**	-0.292**	0.006	-0.330**	-0.043	0.178**
FLL	0.209**	-0.104	-0.035	1.00	0.216**	-0.091	0.176**	0.327**	0.08	0.186**	-0.006	0.317**	0.077	0.274**	0.254**	-0.123*	-0.095	0.049	0.082	-0.013	0.068	0.025	0.09	-0.150*
IL	0.09	-0.237**	-0.123*	0.274**	1.00	0.05	0.242**	0.393**	-0.136*	0.037	0.137*	0.250**	0.202**	0.094	0.140*	-0.025	0.162**	0	0.07	0.103	0.039	0.105	0.052	-0.247**
TPL	-0.104	0.037	0.462**	-0.113	0.053	1.00	-0.09	-0.082	0.049	0.023	-0.09	0.015	-0.064	-0.018	-0.022	0.504**	-0.03	-0.109	-0.065	-0.074	-0.157**	-0.083	-0.168**	0.06
PL	-0.101	-0.323**	-0.194**	0.198**	0.305**	-0.131*	1.00	0.256**	-0.130*	0.204**	0.035	0.111	0.018	-0.147*	-0.086	0.035	0.044	0.189**	0.05	0.147*	0.130*	0.133*	0.144*	-0.238**
AL	0.172**	-0.054	-0.164**	0.407**	0.498**	-0.09	0.322**	1.00	0.059	0.191**	0.073	0.203**	0.283**	0.126*	0.126*	-0.162	0.084	0.086	0.124*	0.128*	0.175**	0.145*	0.202**	-0.065
NOS	0.179**	-0.243**	0.064	0.091	-0.154*	0.082	-0.157**	-0.068	1.00	0.087	0.338**	-0.028	-0.059	0.152*	0.085	0.164**	0.112	-0.107	0.041	0.026	0.014	0.038	0.021	-0.127*
SY	0.323**	-0.023	-0.063	0.207**	0.044	0.044	0.227**	0.229**	0.099	1.00	0.179**	0.083	0.09	0.189**	0.211**	0.041	-0.138*	0.309**	0.121*	0.071	-0.029	0.107	-0.001	-0.104
SI	0.106	-0.272**	-0.145*	0.01	0.156**	-0.111	0.039	0.094	0.378**	0.196**	1.00	-0.077	0.021	0.065	0.027	-0.025	0.153*	0.041	0.198**	0.175**	0.119*	0.219**	0.158**	-0.322**
LL	0.095	-0.098	-0.026	0.414**	0.312**	0.028	0.150*	0.303**	-0.031	0.113	-0.098	1.00	0.176**	0.247**	0.181**	0.012	0.03	0.233**	0.015	0.079	0.079	0.066	0.093	-0.039
LW	-0.063	0.221**	0.05	0.101	0.211**	-0.058	0.024	0.359**	-0.077	-0.099	0.02	0.208**	1.00	0.009	-0.032	0.033	-0.077	-0.036	-0.107	-0.023	0.194**	-0.068	0.166**	0.071
GFY	0.573**	0.151*	-0.132*	0.321**	0.108	0.01	0.191	0.192**	0.172**	0.221**	0.074	0.340**	0.027	1.00	0.654**	0.022	-0.112	-0.037	0.157**	0.022	0.088	0.049	0.053	-0.045
DMY	0.497**	0.007	-0.054	0.338**	0.188**	0.038	0.116	0.272**	0.08	0.273**	0.048	0.291**	0.014	0.641**	1.00	0.023	-0.034	0.021	0.171**	0.028	0.079	0.099	0.036	0.004
NOL	-0.093	-0.137*	0.345**	-0.182**	0.06	0.738**	-0.009	-0.246**	0.277**	0.047	-0.023	0.079	0.018	0.055	-0.089	1.00	-0.042	-0.084	-0.171**	-0.11	-0.238**	-0.156**	-0.270**	0.147*
CPg	-0.079	-0.154*	-0.045	-0.089	0.159**	-0.088	0.057	0.105	0.144*	-0.152*	0.171	0.015	-0.086	-0.134	-0.047	-0.097	1.00	0.138*	0.232**	0.213**	0.065	0.264**	0.114	-0.179**
CPf	0	-0.022	-0.227**	0.054	0.004	-0.192**	0.206**	0.105	-0.131*	0.350**	0.044	0.277	-0.036	-0.038	0.034	-0.155*	0.149*	1.00	0.049	0.459**	0.117	0.376**	0.124*	-0.153*
GP	0.197**	-0.043	-0.344**	0.061	0.125*	-0.105	0.04	0.238**	0.062	0.141*	0.284**	0.05	-0.112	0.213**	0.236**	-0.259**	0.328**	0.051	1.00	0.327**	0.153*	0.679**	0.054	-0.228**
SL	-0.023	0.021	-0.325**	0.008	0.11	-0.137*	0.192**	0.155**	0.037	0.079	0.201**	0.106	-0.026	0.033	0.04	-0.142*	0.256**	0.520**	0.446**	1.00	0.159**	0.914**	0.219**	-0.393**
SDW	-0.07	0.013	0.007	0.076	0.036	-0.200**	0.148*	0.204**	0.014	-0.028	0.121*	0.103	0.215**	0.094	0.085	-0.348**	0.073	0.122*	0.204**	0.169**	1.00	0.05	0.976**	-0.350**
SVI	0.052	-0.003	-0.375**	0.03	0.124*	-0.142*	0.165**	0.201**	0.051	0.111	0.260**	0.101	-0.066	0.05	0.117	-0.201**	0.320**	0.426**	0.721**	0.942**	0.05	1.00	0.185**	-0.402**
SVII	-0.034	-0.003	-0.045	0.092	0.059	-0.212**	0.158**	0.247**	0.023	0	0.167**	0.116	0.192**	0.058	0.045	-0.392**	0.126*	0.129*	0.139	0.235**	0.986**	0.163**	1.00	-0.398**
EC	-0.092	0.233**	0.194**	-0.169**	-0.277**	0.086	-0.254**	-0.06	-0.147*	-0.127*	-0.344**	-0.076	0.074	-0.061	-0.008	0.216**	-0.229**	-0.174**	-0.317**	-0.460**	-0.373**	-0.471**	-0.425**	1.00

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

TABLE 3
Path coefficient analysis for 24 characters of 92 oat genotypes

DF	DM	FLL	IL	TPL	PL	AL	NOS	SY	SI	LL	LW	GFY	NOLS	CPg	CPf	GP	SL	SDW	SVI	SVII	EC
-0.02933	-0.01154	0.01018	0.00361	-0.02	0.00363	-0.00763	-0.0001	0.05159	-0.00209	0.00604	-0.0042	0.32715	0.0378	-0.00431	0.00004	0.04709	-0.03441	0.12842	-0.08201	-0.05797	-0.01992
-0.2288	0.01465	-0.00505	-0.00953	0.00718	0.01163	0.00242	0.00014	-0.00373	0.00535	-0.00626	0.01464	0.08645	0.05611	-0.00839	0.002	-0.01038	0.03161	-0.02288	0.00477	-0.00525	0.05059
-0.02833	0.11832	-0.00172	-0.00495	0.08918	0.00697	0.00731	-0.00004	-0.01011	0.00286	-0.00168	0.00335	-0.0756	-0.14064	-0.00247	0.02064	-0.08223	-0.48547	-0.01269	0.59149	-0.07513	0.04203
0.0237	-0.00419	0.04872	0.01101	-0.02178	-0.00715	-0.01809	0.00005	0.03308	0.00019	0.02639	0.00668	0.18302	0.07442	-0.00486	-0.00487	0.01464	0.01205	-0.13958	-0.04682	0.15536	-0.03663
0.0543	-0.01458	0.01337	0.04013	0.01016	-0.011	-0.02215	0.00009	0.007	-0.00307	0.01992	0.01397	0.06164	0.02436	0.00871	-0.00036	0.02982	0.16355	-0.06614	-0.19548	0.10041	-0.06016
-0.0085	0.05464	-0.0055	0.00211	0.19311	0.00471	0.004	-0.00005	0.00706	0.00218	0.00181	-0.00381	-0.00558	-0.30128	-0.00481	0.01745	-0.02508	-0.20419	0.36654	0.22323	-0.35817	0.01869
0.07382	-0.02289	0.00967	0.01225	-0.02525	-0.036	-0.01433	0.00009	0.03631	-0.00077	0.00957	0.00159	-0.1092	0.00381	0.0031	-0.0187	0.00945	0.28684	-0.26978	-0.26043	0.26607	-0.05504
0.01245	-0.01943	0.01981	0.01998	-0.01737	-0.01161	-0.0445	0.00004	0.0365	-0.00185	0.01937	0.02381	0.10938	0.10059	0.00575	-0.00951	0.0568	0.23194	-0.37288	-0.31715	0.41619	-0.01303
0.05565	0.00753	-0.00444	-0.00617	0.01585	0.00565	0.00303	-0.0006	0.01573	-0.00743	-0.00199	-0.00512	0.09823	-0.11299	0.00786	0.01193	0.01476	0.0548	-0.02562	-0.08076	0.03828	-0.03196
0.00535	-0.00749	0.0101	0.00176	0.00854	-0.0082	-0.01017	-0.00006	0.15961	-0.00384	0.00718	-0.00659	0.1263	-0.01933	-0.00829	-0.03177	0.03379	0.11753	0.05066	-0.17495	-0.00034	-0.02748
0.06232	-0.01721	-0.00047	0.00627	-0.02144	-0.00142	-0.00419	-0.00021	0.03125	0.01963	-0.00623	0.00135	0.04246	0.00955	0.00935	-0.004	0.06796	0.29935	-0.22166	-0.40984	0.28221	-0.07457
0.02246	-0.00311	0.02015	0.01252	0.00547	-0.00541	-0.0135	0.00002	0.01796	0.00192	0.06382	0.01378	0.1942	-0.0324	0.00079	-0.02512	0.01199	0.15832	-0.18763	-0.15966	0.19609	-0.01656
-0.05053	0.00597	0.00491	0.00846	-0.01111	-0.00087	-0.01598	0.00004	-0.01586	-0.0004	0.01327	0.06628	0.01515	-0.00746	-0.00472	0.00326	-0.02669	-0.03916	-0.39274	0.10398	0.3239	0.01602
-0.03465	-0.01566	0.01562	0.00433	-0.00189	0.00689	-0.00852	-0.0001	0.03531	-0.00146	0.02171	0.00176	0.57085	-0.02258	-0.00732	0.00343	0.05079	-0.0487	0.17158	-0.07885	-0.0976	-0.01314
0.03145	0.04077	-0.00888	-0.00239	0.14253	0.00034	0.01096	-0.00015	0.00756	0.00046	0.00507	0.00121	0.03157	-0.4082	-0.00528	0.01404	-0.06185	-0.212	0.63648	0.31684	-0.66201	0.0468
0.03512	-0.00534	-0.00434	0.00639	-0.017	-0.00204	-0.00468	-0.00008	-0.02421	-0.00336	0.00093	-0.00573	-0.07645	0.0394	0.05466	-0.01352	0.07825	0.38272	-0.1336	-0.50466	0.21191	-0.04961
0.00503	-0.0269	0.00262	0.00016	-0.03712	-0.00742	-0.00466	0.00007	0.05586	-0.00087	0.01766	-0.00238	-0.02155	0.06313	0.00814	-0.0908	0.0123	0.7755	-0.22256	-0.67103	0.21708	-0.03778
0.00994	-0.04072	0.00299	0.00501	-0.02027	-0.00143	-0.01058	-0.00003	0.02258	-0.00558	0.0032	-0.00741	0.12137	0.10569	0.0179	-0.00467	0.2389	0.66542	0.3727	-0.13525	-0.06554	-0.06892
-0.00485	-0.03849	0.00039	0.0044	-0.02643	-0.00693	-0.00691	-0.00002	0.01257	-0.00394	0.00677	-0.00174	-0.01863	0.05799	0.01402	-0.04717	0.10653	0.49218	-0.30926	-0.48437	0.39737	-0.09981
-0.00286	0.00082	0.00372	0.00145	-0.03871	-0.00532	-0.00907	-0.00001	-0.00442	-0.00238	0.00655	0.01424	-0.05357	0.14209	0.00399	-0.01105	-0.0487	0.25238	-0.2885	-0.07921	0.66501	-0.08087
0.00069	-0.04442	0.00145	0.00498	-0.02736	-0.00596	-0.00896	-0.00003	0.01773	-0.00511	0.00647	-0.00437	0.02857	0.0821	0.01751	-0.03867	0.17216	0.40602	-0.09194	-0.5753	0.27578	-0.10224
0.00071	-0.00527	0.00448	0.00239	-0.04098	-0.00568	-0.01097	-0.00001	-0.00003	-0.00328	0.00741	0.01272	-0.03301	0.1601	0.00686	-0.01167	-0.00928	0.35131	-0.80377	-0.2574	0.68783	-0.09236
-0.05332	0.02291	-0.00822	-0.01112	0.01662	0.00914	0.00267	0.00008	-0.0202	0.00674	-0.00487	0.00489	-0.03455	-0.088	-0.01249	0.0158	-0.07584	-0.68603	0.68114	0.74193	-0.71812	0.21709

PH- Plant height (cm), DF - NO. of days to 50% flowering, DM- Number of days to maturity, FLL- Flag leaf length (cm), IL- Internode length (cm), TPL-Number of tillers per plant, PL- Peduncle length (cm), AL- Axis length (cm), NOS- Number of spikelets per panicle, SY- Seed yield(g), SI-100 seed weight(g), LL- Leaf length(cm), LW- Leaf width(cm), GFY- Green fodder yield(kg), DMY- Dry matter yield(kg), NOLS- Number of leaves per plant, CPg- Crude protein in grain (%), CPf- Crude protein in forage (%) GP- Germination %, SL- Seedling length(cm), SDW- Seedling dry weight(mg), SVI- Seed vigour index-1, SVII- Seed vigour index-2, EC- Electrical conductivity(mS/cm/seed).

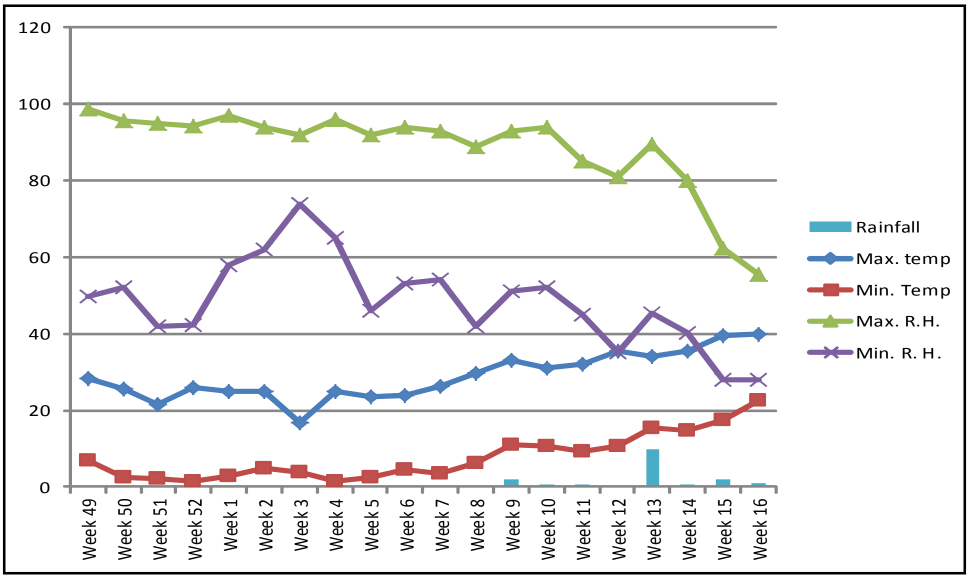

Fig. 1. Agro-meteorological data during the period of experimentation from November 2015 to April 2016.

had a negative and significant correlation with green fodder yield and dry matter yield as well.

Traits like plant height, flag leaf length, internode length, axis length, seed yield, leaf length, green fodder yield and germination percentage showed positive and highly significant correlation amongst each other. Highest value of positive and significant correlation was observed between green fodder yield and dry matter yield (0.654) followed by plant height (0.391), flag leaf length (0.254) and seed yield (0.211). Positive and non-significant correlation exhibited by traits like days to 50% flowering, number of spikelets/ panicle, seed index, crude protein forage, seedling length, seedling dry weight, seed vigour index-I and seed vigour index-II while it showed negative and non-significant with remaining characters.

Plant height exhibited positive correlation with flag leaf length, axis lengh, spikelets/panicle, number of tillers/plant, days to 50% flowering, days to maturity, seed yield, green fodder yield and dry matter yield and negative correlation with peduncle length and 100 seed weight. Ziya *et al*., (2001), Kumar *et al*., (2004), Lorencetti *et al*. (2006), Surje and De (2014), Ahmed *et al*. (2013), Krishna *et al*. (2014) and Kumar, *et al*. (2016) also reported similar results.

Path Coefficient Analysis

Partitioning of the total correlation coefficient into direct and indirect effects for dry matter yield

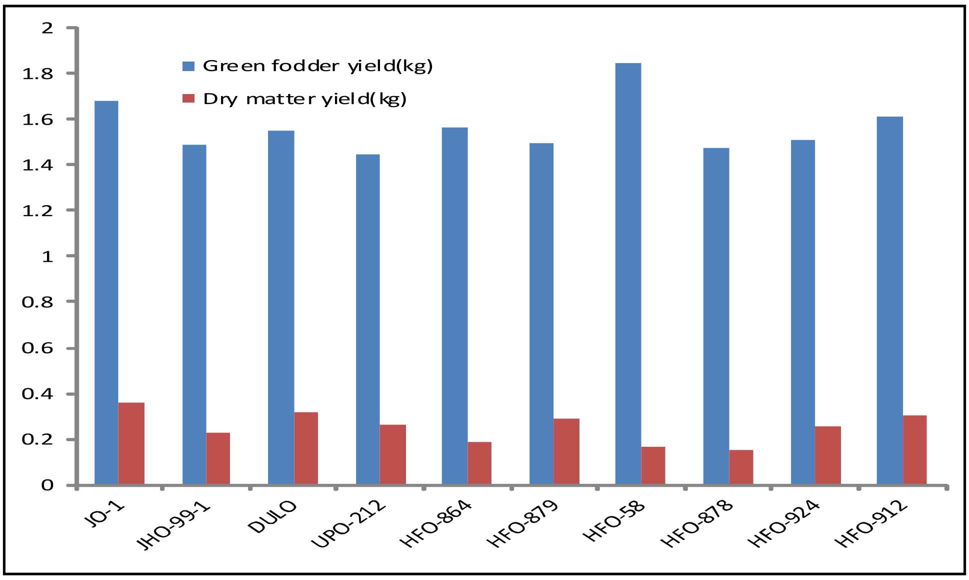

Fig. 2. Mean performance of top 10 genotypes of oat for green fodder yield and dry matter yield.

showed a positive direct effect of yield contributing traits viz. green fodder yield (0.5709), tillers per plant (0.1931), plant height (0.1554) and seed yield per meter row length (0.1596) while days to 50% flowering (-0.2288), peduncle length (-0.036), axis length (-0.0445) and number of leaves per plant (-0.4082) had negative direct effects on dry matter yield per plant (Table 3).

Thus, the improvements in characters such as plant height, green fodder yield, number of tillers per plant and seed yield will help improve fodder yield both directly and indirectly. Negative direct effect was contributed by traits like peduncle length, number of spikelets/panicle, number of leaves per plant and number of days to 50% flowering, however, diluted the positive and direct effect of earlier traits on green fodder yield.

The positive indirect effects were contributed through most of the traits except peduncle length and number of days to maturity (Table 3). Krishna *et al.* (2014) reported positive direct effect on green fodder yield was contributed by leaf stem ratio, dry matter, spike length and number of spikelets per panicle. However indirect effect on improvement in green fodder yield was exerted by most of the traits studied. So a direct selection for all these traits will helps in improvement of green fodder yield. Green fodder yield was positively correlated with most of the traits studied except number of leaves and stem girth. Among different traits, plant height and leaf length showed positive correlation with most of the traits studied.

Positive and significant genotypic correlation values of traits viz., Plant height (0.3272), flag leaf length (0.18302), seed yield (0.1263), leaf length (0.1942), had high positive indirect effects via green fodder yield. The findings of Choubey *et al.* (2001), Vaisi *et al*. (2013), Krishna *et al*. (2014) and Kumar *et al.* (2016) also confirm to our results. In light of the above findings the characters plant height, tillers per plant and longer leaves can be identified as main characters contributing towards dry fodder yield directly and indirectly and selection based on these characters will be effective in developing high yielding fodder oat genotypes. At the same time, progress in breeding for enhanced dry matter yield may be adversely affected by selection for traits like number of leaves per plant and number of days to 50% flowering due to a strong negative association of these traits with dry matter yield.

REFERENCES

Ahmed, S., Roy, A. K. and. Majumdar, A. B. 2013 : Correlation and path coefficient analysis for fodder and grain yield related traits in oats (*Avena sativa* L.). *Annals of Biology*,.**29** : 75-78.

Choubey, R. N., Saiprasad, S. V., Zadoo, S. N. and Roy, A. K. 2001 : Assessment of genetic Diversity and inter-relationships among yield contributing traits in forage Oat germplasm *Forage Research.* **27** : 149-154.

Jellen, E. N. and Leggett, J. M. 2006 : *Cytogenetic Manipulation in Oat Improvement*. In: R. J. Singh and P. P. Jauhar, eds.: Genetic Resources, Chromosome Engineering, and Crop Improvement. pp.199-231, CRC Press, Taylor and Francis Group, Boca Raton, FL 33487-2742. [Paper detailing taxonomy of oats based on cytogenetic considerations].

Klose C, Schehl B. D. and Arendt E. K. 2009 : Fundamental study on protein changes taking place during malting of oats. *J Cereal Sci.* **49** : 83-91.

Krishna, A., Ahmed, S., Pandey, H. C. and Kumar, V. 2014 : Correlation, path and diversity analysis of oat (*Avena sativa* L.) genotypes for grain and fodder yield. *Journal of Plant Science & Research.* **1** : 1-9.

Kumar, P., Phogat, D. S. and Kumari, P. 2016 : Correlation and Path Coefficient Analysis Studies In Oat (AvenaSativa L.). *Forage research.* **42** : 198-200.

Kumar, Y., Jhorar, B. S., Sangwan, O. and Singh, P. 2004 : Character association between grain yield and its components in oat (Avena sativa L.). *National Journal of Plant Improvement*. **6** : 4-6.

Lorencetti, C., F. I. F. de Carvalho, A. C. de Oliveira, I. P. Valerio, I. Hartwig, G. Benin and D. A. M. Schmidt 2006 : Applicability of phenotypic and canonic correlations and path coefficients in the selection of oat genotypes. *Scientia Agricola.*, **63** : 11-19. 21.

Pundir, S. R., Singh, V. P. and Phogat, D. S. 2008 : Genetic variability and interrelationship for various grain and seedling characters in oats. *Forage Res.* **33** : 236-240.

Sangwan, O., Avtar, R., Arora, R. N. and Singh, A. 2012 : Variability and character association studies in fodder oat (*Avena sativa* L.). *Forage Res.* **38** : 56-58.

Surje, D. T. and De, D. K. 2014 : Correlation Coefficient Study in Oat (*Avena sativa* L.) Genotypes for Fodder and Grain Yield Characters. *Journal of Agricultural Science and Technology.* **1** : 89-93.

Vaisi, H., Golparvar, A. R., Resaie, A. and Bahraminejad, S. 2013 : Factor analysis of some quantitative attributes in oat (*Avenasativa* L.) genotypes. *Scientia Agriculturae.* **3** : 62-65.

Ziya, D., R. Kara, T. Dokuyucu and A. Akkya 2001 : Correlation and Path Analysis of Grain Yield and Yield Components of some Turkish Oat Genotypes. *Agron. J.*, **43** : 214-218.