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Study of character association and path coefficient analysis for quantitative and qualitative traits in multi-cut oat

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Abstract
The present experiment was conducted at Forage Section Department of Genetics & Plant Breeding, Chaudhary Charan Singh Haryana Agricultural University, Hisar with 92 genotypes collected from different eco-geographical regions during *rabi* 2015-16to estimate the magnitude of correlation among yield and quality traits and their effects in multi-cut Oat.

In 1st cut of multi-cut, positive and significant correlations of dry matter yield per meter row length were recorded for plant height, number of tillers per plant and green fodder yield at genotypic as well as phenotypic level while in 2nd cut plant height, number of tillers per plant, germination percentage, seed vigour index-I and green fodder yield had positive and highly significant correlation at genotypic as well as phenotypic level with dry matter yield. Path coefficient analysis in 1st cut revealed positive and direct effect of green fodder yield (0.8902) and yield contributing traits viz., tillers per plant (0.1518), plant height (0.1401), germination percentage (0.3403), seedling length (0.9877), seedling dry weight (0.4166), seedling vigour index-I (0.8125) and seedling vigour index-II (0.3148) while crude protein (-0.1341) had negative direct effects on dry matter yield per plant. Whereas, in 2nd cut positive and high direct effects of green fodder yield (0.9164), tillers per plant (0.2341) and plant height (0.1401), while days to 50% flowering (-0.089), length (-0.0769), axis length (-0.0945), and number of leaves per plant (-0.1473) had negative direct effects on dry matter yield per plant.

Therefore, it would be better to emphasize on characters viz. green fodder yield, number of tillers per plant and plant height in 1st and 2nd cut and seed yield per meter row length can be used in 2nd cut for the improvement of dry matter yield.

Keywords: correlation, path coefficient, *Avena sativa* L., selection, variability, fodder

Introduction

Oat (*Avena sativa* L.) is a cereal crop of global importance, belonging to the family Poaceae. aOat remains as an important cereal crop in the developing world and it is widely preferred in developed countries. It is not possible to increase the area under fodder crops due to pressure of more remunerative crops like wheat. Therefore, the only way out is to evolve multi-cut varieties which give more tonnage per unit area and per unit of time. Generally oat is grown as a sole crop but it can also be grown as intercrop with berseem to give a more nutritious fodder. Farmers face the scarcity of fodder during the winter and they have to feed the cattle with dry stalks of pearl millet or wheat bhusa or paddy straw (parali). Under such situations oat crop grows very well and can make good the deficiency of green fodder. It can be used as a green fodder in crop season or as hay or silage in off- season to supply quality fodder.

Yield is a quantitative character which is contributed by a number of different component traits. Therefore, to determine the association of 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 an alternative selection criterion 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 (Poonia *et al* 2017) [8].

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. Therefore, in the 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 multi-cut Oat involving 11 and 18 characters for 1st and 2nd cut, respectively. All the recommended agronomical package of practices were followed and the genotypes were raised in a Randomized Block Design with three replications keeping row to row distance 45 cm. The observations were recorded on five randomly selected plants of each genotype in each replication for the morphological characters, seed quality parameters and quality characters. The phenotypic and genotypic correlation coefficients were computed from the phenotypic and genotypic variances and co-variances according to Searle (1961) [9]. The direct and indirect effects were estimated through path coefficient analysis as suggested by Wright (1921) [12] and elaborated by Dewey and Lu (1959) [2].

Results and Discussion

Genotypic and phenotypic correlation coefficients

Correlation coefficient analysis in Ist cut of multi-cut oat

The Analysis of variance revealed that all the characters observed were highly significant, thereby showing that there was enough variability among the genotypes for characters studied. Results indicated that many yield contributing traits viz., plant height, number of tillers per plant and dry matter yield had positive and highly significant correlation with green fodder yield both at genotypic and phenotypic level (Table 1 and figure 1) indicating that the selection based on these characters will result in improvement of the green fodder yield in oat. Further perusal of the data revealed that crude protein had negative and significant correlation with green fodder yield and dry matter yield. The traits like plant height, green fodder yield, germination percentage, seedling length and seed vigour index-I showed positive and highly significant correlation with each other. The highest value of positive and significant correlation was observed between green fodder yield and dry matter yield followed by plant height, germination percentage, number of tillers per plant and seed vigour index-I.

Table 1: Phenotypic (above diagonal) and genotypic (below diagonal) correlation coefficients among 11 characters of 92 genotypes in 1st cut of multi cut oat

	PH	TPL	GFY	DMY	CP	GP	SL	SDW	SVI	SVII	EC
PH	1.00	-0.274**	0.488**	0.471**	0.137*	0.172**	0.092	0.011	0.142*	0.049	-0.188**
TPL	-0.119**	1.00	0.072	0.116	-0.126*	-0.120*	-0.113	-0.261**	-0.135*	-0.284**	0.127*
GFY	0.323**	0.039	1.00	0.868**	-0.003	-0.088	-0.075	-0.088	-0.097	-0.106	-0.068
DMY	0.191**	0.084	0.873**	1.00	-0.063	-0.105	-0.074	-0.073	-0.103	-0.096	-0.037
CP65	0.219**	-0.209**	-0.018	-0.129*	1.00	0.148*	0.281**	0.038	0.280**	0.065	-0.208**
GP	0.336**	-0.180**	0.125*	0.016	0.177**	1.00	0.327**	-0.153*	0.679**	0.054	-0.228**
SL	0.142*	-0.202**	0.074	0.078	0.387**	0.446**	1.00	0.159**	0.914**	0.219**	-0.393**
SDW	0.011	-0.328**	0.104	0.097	0.047	-0.204**	0.169**	1.00	0.05	0.976**	-0.350**
SVI	0.230**	-0.217**	0.103	0.118	0.366**	0.721**	0.942**	0.05	1.00	0.185**	-0.402**
SVII	0.067	-0.360**	0.102	0.123*	0.077	-0.039	0.235**	0.986**	0.163**	1.00	-0.398**
EC	-0.279**	0.174**	-0.086	-0.057	-0.277**	-0.317**	-0.460**	-0.373**	-0.471**	-0.425**	1.00

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

PH- Plant height(cm), TPL-Number of tillers per plant, GFY- Green fodder yield (Kg), DMY- Dry matter yield (Kg), NOLS- Number of leaves per plant, 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).

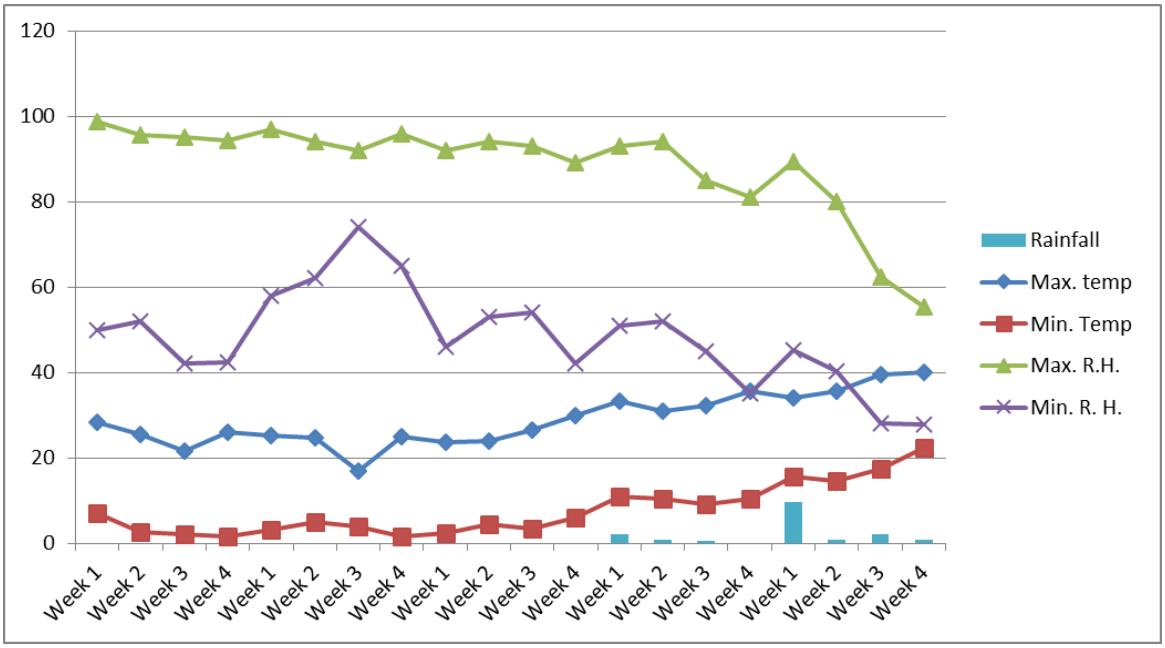

Fig 1: Agro-meteorological data during the period of experimentation from November 2015 to April 2016.

Positive and non-significant correlation exhibited by traits like number of tillers per plant, germination percentage, seedling length, seedling dry weight, seed vigour index-I and seed vigour index-II while it showed negative and non-significant correlation with the remaining characters. Plant height exhibited positive correlation with crude protein, germination percentage, seedling length, seed vigour index-I & II, green fodder yield and dry matter yield and negative correlation with number of tillers per plant, and electrical conductivity. Seed characters showed positive correlation with each other but electrical conductivity was found to be negatively and significantly correlated. Crude protein content was found to be negatively and non-significantly associated with number of tillers per plant, dry matter yield and green fodder yield. The findings of Vaisi *et al*. (2013) [11] and Kumar *et al.* (2016) [6] also confirm to our results.

1.2 Path coefficient analysis in 1st cut of multi-cut oat

Partitioning of the total correlation coefficient into direct and indirect effects for dry matter yield showed a positive direct effect of green fodder yield (0.8902), and yield contributing traits viz. tillers per plant (0.1518), plant height (0.1401), germination percentage (0.3403), seedling length(0.9877), seedling dry weight (0.4166), seedling vigour index-I (0.8125) and seedling vigour index-II (0.3148) while crude protein (-0.1341) had negative direct effects on dry matter yield per plant (Table 2).

Thus, the improvements in characters such as plant height, green fodder yield, number of tillers per plant and seedling vigour index-I & II will help improve fodder yield both directly and indirectly. Most of the traits showed positive indirect effect on green fodder yield except seedling length, germination percentage and seedling vigour index-II (Table 2). So a direct selection for all these traits will helps in improvement of dry matter yield and green fodder yield. Positive and significant genotypic correlation values of traits viz., Plant height (0.2874) and number of tillers per plant (0.0343) had high positive indirect effects via green fodder yield. Similar findings were reported by Vaisi *et al*. (2013) [11], Krishna *et al*. (2014) [5] and Kumar *et al.* (2016) [6] also confirm to our results.

Table 2: Path coefficient analysis for11 characters of 92 genotypes in 1st cut of multi cut oat

	PH	TPL	GFY	CP	GP	SL	SDW	SVI	SVII	EC
PH	0.1401	0.06355	0.28744	-0.02938	0.11437	0.13989	-0.00448	-0.27888	0.0212	0.01689
TPL	0.05867	0.15175	0.0343	0.02798	-0.06134	-0.19953	0.13663	0.26307	-0.11322	-0.01055
GFY	0.04524	0.00585	0.89019	0.00236	-0.04262	0.07265	0.04314	0.12508	-0.03845	0.00521
CP	-0.03069	0.03165	-0.01568	-0.1341	0.06034	0.38183	-0.01943	-0.44364	0.02413	0.01676
GP	0.04709	0.02736	-0.11149	-0.02378	0.34025	0.44047	0.08492	-0.87378	-0.01222	0.01922
SL	0.01984	0.03066	-0.06547	-0.05185	0.15173	0.98774	-0.07047	-1.1425	0.07411	0.02783
SDW	0.00151	0.04977	-0.09216	-0.00625	-0.06935	0.16706	0.41664	-0.06097	0.31051	0.02255
SVI	0.03222	0.03292	-0.09183	-0.04907	0.2452	0.9307	-0.02095	0.81251	0.05143	0.02851
SVII	0.00944	0.05459	-0.10874	-0.01028	-0.01321	0.23254	-0.41101	-0.19812	0.31477	0.02576
EC	-0.00944	0.05459	-0.10874	-0.01028	-0.01321	0.23254	-0.41101	-0.19812	0.31477	0.02576

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

PH- Plant height(cm), TPL-Number of tillers per plant, GFY- Green fodder yield (Kg), DMY- Dry matter yield (Kg), NOLS- Number of leaves per plant, 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)

2.1 Correlation coefficient analysis in 2nd cut of multi-cut variety

The Analysis of variance revealed that all the characters observed were highly significant, thereby showing that there was enough variability among the genotypes for characters studied. Results from the experiment indicated that most of the yield contributing characters viz., plant height, number of tillers per plant and green fodder yield had positive and highly significant correlation at genotypic as well as phenotypic level with dry matter yield (Table 3 and figure 2). Thus, the selection based on these characters will result in improving the dry matter yield in oat. Further perusal of the data revealed that peduncle length, electrical conductivity and crude protein showed negative and significant correlation with green fodder yield and dry matter yield. Positive and non-significant correlation with dry matter yield was exhibited by traits like number of seed index, leaf length, leaf width, number of leaves per plant, seedling length, seedling dry weight, seed vigour index-I & II, while it showed negative and non-significant with remaining characters.

Plant height exhibited positive and significant correlation with flag leaf length, inter-node length, peduncle length, axis length, seed index, leaf length, leaf width, green fodder yield & dry matter yield and germination percentage while positive and non-significant correlation with seedling length, seedling dry weight, seed vigour-I and seed vigour index-II. This character showed negative and significant correlation with electrical conductivity and it found negative and non-significant with rest of the characters. Seed characters showed positive correlation with each other but electrical conductivity showed negative and significant association. Crude protein content in 2nd cut was found negative and non-significantly associated with number of tillers per plant, dry matter yield and green fodder yield. Lorencetti *et al*. (2006) [7], Ahmed *et al*. (2013) [1] and Surje and De (2014) [10] also observed similar results.

Crude protein content in 2nd cut forage showed positive and significant correlation with seed index, leaf length, germination %, seedling length, seed vigour index-I and II, whereas it was correlated positively and non-significantly with flag leaf length and seedling dry weight. The negative and significant correlation was observed with days to 50% flowering, green fodder weight, dry fodder weight and electrical conductivity while remaining character had shown negative and non-significant correlation with this character.

2.2 Path coefficient analysis in 2nd cut of multi-cut Oat

Direct and indirect effects of different characters on dry matter yield per plant were calculated in 2nd cut of multi-cut which has been presented in Table 4. A critical perusal of path coefficient analysis exhibited high direct and positive effects of green fodder yield (0.9164), tillers per plant (0.2341) and plant height (0.1401) while days to 50% flowering (-0.089), length (-0.0769), axis length (-0.0945), and number of leaves per plant (-0.1473) had negative direct effects on dry matter yield per plant. This indicated that the green fodder yield, tillers per plant and plant height were the important traits so far as their association with dry matter yield is concerned.

Plant height (0.1821), days to 50% flowering (0.1803), leaf width (0.1105), had high positive indirect effects via green fodder yield and numbers of tillers per plant (1467) via number of leaves per plant while inter-node length (-0.1537) and peduncle length (-0.2761) had negative indirect effect via green fodder yield. 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. 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 results of the experiment were found to be in correlation with the findings of Vaisi *et al*. (2013) [11], Ahmed *et al*. (2013) [1], Krishna *et al*. (2014) [5] and Kumar *et al.* (2016) [6]. A number of researchers indicate relatively high heritability of protein content. Normally, however, high protein content is negatively correlated with grain yield (Humphreys & Mather, 1996) [3]. The protein level is determined both by genotype and environmental effects. A number of studies show that nitrogen fertilisation increased protein content in oat kernels. Therefore, the protein content can be managed both by proper choice of cultivar and by optimal level of fertilisation (Fan *et al.*, 2009) [4].

Krishna *et al.* (2014) [5] found positive direct effect on green fodder yield was contributed by plant height, number of tillers, 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 these characters will directly help in improvement of green fodder yield and dry matter yield. Green fodder yield was positively associated with most of the characters 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.

In light of the above findings the characters green fodder yield, plant height, number of tillers per, flag leaf length and broad and longer leaves can be identified as main characters contributing towards dry fodder yield directly and indirectly, consequently 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 peduncle length, number of leaves per plant and number of days to 50% flowering, as these traits showed strong negative correlation with dry matter yield.

Table 3: Phenotypic (above diagonal) and genotypic (below diagonal) correlation coefficients among 20 characters of 92 genotypes in 2nd cut of multi cut oat

	PH	DM	FLL	IL	TPL	PL	AL	SI	LL	LW	GFY	DMY	NOL	CP	GP	SL	SDW	SVI	SVII	EC
PH	1.00	-0.035	0.186**	0.325**	0.123*	0.123*	0.425**	0.162**	0.304**	0.130*	0.196**	0.205**	-0.107	-0.015	0.06	0.004	0.041	0.026	0.051	-0.199**
DM	-0.05	1.00	-0.044	-0.126*	0.360**	-0.140*	-0.118	-0.133*	-0.057	0.034	0.129*	0.104	0.223**	-0.229**	-0.251**	-0.292**	0.006	-0.330**	-0.043	0.178**
FLL	0.222**	-0.037	1.00	0.227**	-0.087	0.200**	0.287**	0.001	0.271**	0.089	0.068	0.058	-0.127*	0.075	0.062	-0.018	0.064	0.013	0.082	-0.153*
IL	0.527**	-0.132*	0.309**	1.00	-0.039	0.198**	0.392**	0.141*	0.198**	0.200**	-0.084	-0.076	-0.028	0.057	0.076	0.116	0.06	0.117	0.073	-0.256**
TPL	-0.211**	0.487**	-0.128*	-0.061	1.00	-0.075	-0.092	-0.087	0.044	-0.033	0.322**	0.311**	0.555**	-0.161**	-0.120*	-0.113	-0.261**	-0.135*	-0.284**	0.127*
PL	0.173**	-0.183**	0.239**	0.257**	-0.089	1.00	0.264**	0.035	0.122*	-0.028	-0.182**	-0.171**	-0.006	0.160**	0.062	0.089	0.102	0.097	0.118*	-0.210**
AL	0.495**	-0.151*	0.350**	0.559**	-0.163**	0.325**	1.00	0.112	0.371**	0.284**	-0.027	-0.010	-0.175**	0.053	0.142*	0.140*	0.163**	0.162**	0.196**	-0.058
SI	0.211**	-0.145*	-0.001	0.177**	-0.118	0.035	0.121*	1.00	-0.104	0.021	0.004	0.003	-0.025	0.180**	0.198**	0.175**	0.119*	0.219**	0.158**	-0.322**
LL	0.315**	-0.075	0.344**	0.297**	0.036	0.126*	0.233**	-0.127*	1.00	0.247**	0.051	0.054	0	0.195**	0.096	0.094	-0.003	0.112	0.021	0.012
LW	0.170**	0.051	0.111	0.219**	-0.08	-0.035	0.346**	0.021	0.295**	1.00	0.077	0.086	0.032	-0.088	-0.107	-0.023	0.195**	-0.068	0.166**	0.071
GFY	-0.179**	0.177**	0.056	-0.151*	0.007	-0.272**	-0.094	0.001	0.026	0.109	1.00	0.965**	-0.009	-0.134*	-0.092	-0.132*	0.113	-0.140*	0.099	-0.01
DMY	-0.163**	0.152*	0.05	-0.129*	-0.002	-0.254**	-0.073	-0.004	0.026	0.132*	0.976**	1.00	0.015	-0.123*	-0.091	-0.114	0.139*	-0.126*	0.126*	-0.025
NOL	-0.159**	0.345**	-0.201**	-0.088	0.996**	-0.083	-0.255**	-0.023	0.055	0.018	0.001	0.023	1.00	-0.072	-0.171**	-0.11	-0.238**	-0.156**	-0.270**	0.147*
CP	-0.024	-0.245**	0.096	0.075	-0.237**	0.199**	0.085	0.208**	0.253**	-0.11	-0.166**	-0.157**	-0.135*	1.00	0.155**	0.469**	0.094	0.428**	0.125*	-0.306**
GP	0.128*	-0.344**	0.032	0.143*	-0.180**	0.113	0.261**	0.284**	0.162**	-0.111	0.133*	0.138*	-0.259**	0.211**	1.00	0.327**	-0.153*	0.679**	0.054	-0.228**
SL	-0.006	-0.325**	0	0.129*	-0.202**	0.136*	0.157**	0.201**	0.102	-0.026	0.229**	0.204**	-0.142*	0.548**	0.446**	1.00	0.159**	0.914**	0.219**	-0.393**
SDW	0.055	0.007	0.075	0.061	-0.328**	0.120*	0.195**	0.121*	0	0.215**	0.153*	0.186**	-0.348**	0.108	-0.204**	0.169**	1.00	0.05	0.976**	-0.350**
SVI	0.042	-0.375**	0.013	0.145*	-0.217**	0.149*	0.212**	0.260**	0.140*	-0.066	0.224**	0.207**	-0.201**	0.503**	0.721**	0.942**	0.05	1.00	0.185**	-0.402**
SVII	0.08	-0.045	0.085	0.088	-0.360**	0.142*	0.240**	0.167**	0.029	0.192**	0.139*	0.172**	-0.392**	0.142*	-0.039	0.235**	0.986**	0.163**	1.00	-0.398**
EC	-0.266**	0.194**	-0.173**	-0.306**	0.174**	-0.225**	-0.09	-0.344**	0.002	0.073	-0.007	-0.019	0.216**	-0.351**	-0.317**	-0.460**	-0.373**	-0.471**	-0.425**	1.00

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

PH- Plant height(cm), DF - No. of days to 50% flowering, F LL- Flag leaf length(cm), IL- Internode length(cm), TPL-Number of tillers per plant, PL- Peduncle length(cm), AL- Axis length(cm), SI- Seed index, LL- Leaf length (cm), LW- Leaf width(cm), GFY- Green fodder yield(Kg), DMY- Dry matter yield(Kg), NOLS- Number of leaves per plant, CP2- 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).

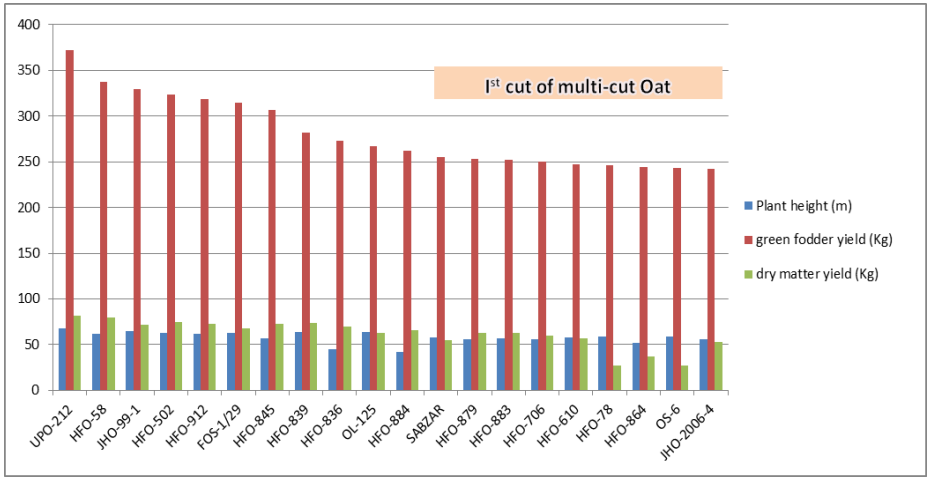

Fig 2: Mean performance of top 20 genotypes of oat for traits showing positive and significant correlation in 1st cut of multi-cut Oat

Table 4: Path coefficient analysis for20 characters of 92 genotypes in 2nd cut of multi cut Oat

	PH	Df	FLL	IL	TPL	PL	AL	SI	LL	LW	GFY	NOLS	CP	G	SL	SDW	SVI	SVII	EC
PH	0.10405	0.00442	0.00189	0.01969	-0.04928	0.00378	-0.04677	-0.0059	-0.02418	0.00953	0.18212	0.02336	-0.00156	-0.00099	0.00212	0.05194	0.01965	-0.06622	-0.02618
Df	-0.00517	-0.089	-0.00031	-0.00492	0.1141	-0.00401	0.01424	0.00407	0.00576	0.00284	0.18027	-0.05075	-0.01592	0.00266	0.11172	0.00651	-0.17605	0.03699	0.01907
FLL	0.02314	0.00326	0.0085	0.01156	-0.02992	0.00523	-0.0331	0.00003	-0.02642	0.00621	0.05707	0.02958	0.00623	-0.00024	0.00007	0.07016	0.00595	-0.07048	-0.017
IL	0.05486	0.01171	0.00263	0.03735	-0.01422	0.00564	-0.05282	-0.00494	-0.02281	0.0123	-0.1537	0.01297	0.00489	-0.0011	-0.04416	0.05733	0.06789	-0.07299	-0.03014
TPL	-0.0219	-0.04336	-0.00109	-0.00227	0.23411	-0.00196	0.01541	0.0033	-0.00277	-0.00447	0.00723	0.14667	-0.0154	0.00139	0.06937	-0.30736	-0.10173	0.29895	0.01717
PL	0.01796	0.01627	0.00203	0.0096	-0.02094	0.02192	-0.03074	-0.00099	-0.00969	-0.00194	-0.2761	0.01224	0.01293	-0.00088	-0.04656	0.11204	0.06981	-0.11843	-0.02219
AL	0.05152	0.01342	0.00298	0.02089	-0.03819	0.00713	-0.0945	-0.00338	-0.01788	0.01943	-0.0954	0.03757	0.00553	-0.00202	-0.05387	0.18235	0.09952	-0.19959	-0.0089
SI	0.02195	0.01294	-0.00001	0.00661	-0.02765	0.00078	-0.01141	-0.0279	0.00973	0.00117	0.00133	0.00345	0.01349	-0.0022	-0.06889	0.11362	0.12198	-0.13896	-0.03384
LL	0.03274	0.00667	0.00292	0.01109	0.00844	0.00276	-0.02197	0.00354	-0.0769	0.01655	0.02688	-0.00813	0.01641	-0.00125	-0.03511	-0.00019	0.0655	-0.02445	0.00023
LW	0.01766	-0.0045	0.00094	0.00818	-0.01863	-0.00076	-0.03269	-0.00058	-0.02266	0.05613	0.1105	-0.00264	-0.00717	0.00086	0.00891	0.20164	-0.0308	-0.15983	0.00724
GFY	-0.01864	-0.01578	0.00048	-0.00565	0.00167	-0.00595	0.00886	-0.00004	-0.00203	0.0061	0.91641	-0.00018	-0.01079	0.00103	0.07855	0.14332	-0.10508	-0.1154	-0.00067
NOLS	-0.0165	-0.03065	-0.00171	-0.00329	0.23314	-0.00182	0.02409	0.00065	-0.00424	0.001	0.00124	-0.1473	-0.00876	0.002	0.04879	-0.32624	-0.0943	0.32598	0.02124
CP	-0.00249	0.02181	0.00082	0.00281	-0.0555	0.00436	-0.00804	-0.0058	-0.01942	-0.00619	-0.16885	0.01986	0.06495	-0.00163	-0.1881	0.10111	0.23602	-0.11806	-0.03453
G	0.01334	0.03062	0.00027	0.00533	-0.0422	0.00249	-0.02468	-0.00795	-0.01244	-0.00626	-0.13545	0.03813	0.01369	-0.0077	-0.15313	-0.19104	0.33789	0.03227	-0.03128
SL	-0.00064	0.02894	0	0.0048	-0.04729	0.00297	-0.01482	-0.00561	-0.00786	-0.00146	-0.23251	0.02093	0.03558	-0.00344	-0.3434	0.15852	0.4418	-0.19567	-0.04529
SDW	0.00577	-0.00062	0.00064	0.00228	-0.07677	0.00262	-0.01838	-0.00339	0.00002	0.01208	0.15543	0.05127	0.00701	0.00157	-0.05808	0.93725	0.02358	-0.81987	-0.0367
SVI	0.00436	0.0334	0.00011	0.00541	-0.05079	0.00326	-0.02005	-0.00727	-0.01074	-0.00369	-0.22778	0.02962	0.0327	-0.00556	-0.32356	0.04713	0.46887	-0.1358	-0.0464
SVII	0.00829	0.00396	0.00072	0.00328	-0.08421	0.00312	-0.02268	-0.00467	-0.00226	0.01079	0.14112	0.05777	0.00923	0.0003	-0.08085	0.92458	0.07661	-0.8311	-0.04191
EC	-0.02765	-0.01722	-0.00147	-0.01143	0.04079	-0.00494	0.00853	0.0096	-0.00018	0.00412	-0.00694	-0.03175	-0.02277	0.00245	0.15787	-0.34914	-0.22082	0.35361	0.09851

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

PH- Plant height(cm), DF - No. of days to 50% flowering, F LL- Flag leaf length(cm), IL- Internode length(cm), TPL-Number of tillers per plant, PL- Peduncle length(cm), AL- Axis length(cm), SI- Seed index, LL- Leaf length (cm), LW- Leaf width(cm), GFY- Green fodder yield(Kg), DMY- Dry matter yield(Kg), NOLS- Number of leaves per plant, CP2- 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).

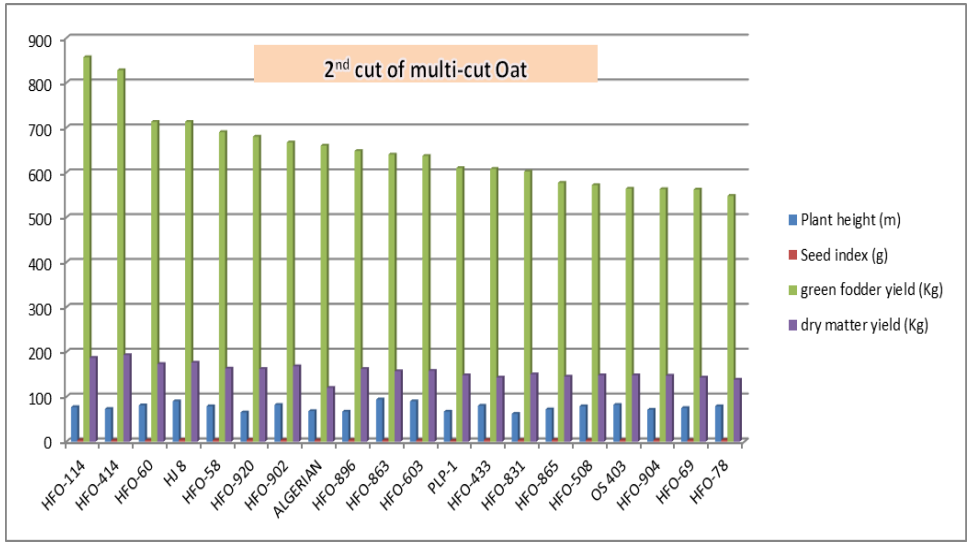

Fig 3: Mean performance of top 20 genotypes of oat for traits showing positive and significant correlation in 2nd cut of multi-cut.

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