APPLICATION OF FACTOR ANALYSIS FOR DIFFERENT GENOTYPES OF BAJRA CROP

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ABSTRACT

The data of large scale varietal trial having 21 genotypes evaluated in three replications at Regional Research Station, Anand during the summer-2013 for bajra were collected and were subjected to factor analysis using SAS software. The data on grain yield per plant (GYP), fodder yield per plant (FYP), Dry earhead weight (DEHW), Effective tiller at basal (ETB), Earhead girth (EHG), Earhead length (EHL), Plant height (PH), Days to maturity (DM), Days to 50% flowering (DF) and 1000 test weight (TWT) were used for the present study. The results revealed that the highest C.V.% (24.5%) was observed for effective tiller (basal) followed by fodder yield per plant (23.2%) and grain yield per plant (22.3). The genotypic correlation coefficients between grain yield of bajra with effective tiller at basal, dry earhead weight, day to 50% flowering and fodder yield per plant were significant and positive at genetic level. In case of fodder yield per plant positive and significant correlation were observed with effective tiller at basal, dry earhead weight, day to 50% flowering and plant height. The result of regression analysis indicated that the positive highest contribution was given by dry earhead weight followed by fodder weight and test weight, while negative contribution was observed for plant height and earhead length for grain yield of bajra. Comparison of results obtained by different methods viz., factor analysis, genotypic correlations and its path analysis and regression analysis using same set of data to identify the yield contributing characters results of average of rank indicated that days to 50% flowering was the important characters identified by all the methods.

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Introduction :

Factor analysis is a multivariate technique to handle large amount of data. It serves as decision making analysis for extracting subsets of co-varying variables or a means of identifying fundamental and meaningful dimension of a multivariate set of data. The analysis was carried out with the objectives (1) To assess the important biometrical characters as per their factor loadings (2) To estimate common variation explained by different factors and (3) To compare the results obtained by factor analysis with regression analysis in identifying important biometrical characters.

Materials and Methods :

There are two main factor analysis methods. One is common factor analysis which extracts factors based on the variance shared by the factors and the other is principal component analysis which extracts factors based on the total variance of factors. Factor loading of 0.5 or higher is required to attribute a specific variable to a factor. An orthogonal rotation assumes no correlation between the factors.

The data of large scale varietal trial having 21 genotypes evaluated in three replications at Regional Research Station, Anand during summer-2013 for bajra were collected and were subjected to factor analysis using SAS **(**PROC Factor) Software (Version 9.3) available at the department.

Results and Discussion :

The data on grain yield per plant (GYP), fodder yield per plant (FYP), Dry earhead weight (DEHW), Effective tiller at basal (ETB), Earhead girth (EHG), Earhead length (EHL), Plant height (PH), Days to maturity (DM), Days to 50% flowering (DF) and 1000 test weight (TWT) were used for the present study. The results revealed that the highest C.V.% (24.5 %) was observed for effective tiller (basal) followed by fodder yield per plant (23.2%) and grain yield per plant (22.3). The lowest CV% was observed for days to maturity (2.3%) (Table 1).

The Eigen values for first three factors were more than one. As per the criteria the factor having minimum Eigen value = 1 or more was selected in the analysis. Thus, first three factors were retained for further analysis (Table 2). This was also supported by the Scree plot criteria (Fig. 1).

The first factor pattern (Table 3) and rotated factor analysis score values are given in Table 4. The results indicated that the first factor included days to 50% flowering, fodder yield per plant and dry earhead weight to be the important factor contributing 26.4% of common variation in bajra. Besides this the second factor consisted earhead girth and length, which can contribute about 20.1 % of common variation, while third factor identified days to maturity and test weight having 15.8 % common variation. The total common variation accounted by all three variables was 62.3 % . Fodder yield, dry erahead weight, days to 50% flowering, ear head girth and length, days to maturity and test weight exhibited more than 0.66 communality which indicates to have high common variation in bajra. Thus, overall result suggested that selection days to 50 % flowering, fodder yield, dry erahead weight, ear head girth and length and days to maturity are more important. Mohamed (1999) found that two factors (grain yield and spike density) accounted for 80.8% of variation among traits in some bread wheat genotypes. Mohsen et al., (2014) studied on multivariate statistical analysis of some traits of bread wheat for breeding under rainfed condition. They reported that rotation accentuated the larger loadings in the extracted factors and suppressed the minor loadings thus improving the opportunity of achieving meaningful interpretation of factors. The factor which made the largest contribution accounted for 28% of the total variation and was composed of the some components of grain yield including stem diameter, leaf width, tiller number, spike length, floret number, spikelet number, grain number and grain yield

The genotypic correlation coefficients between grain yield of bajra with effective tiller at basal, dry earhead weight, day to 50% flowering and fodder yield per plant were significant and positive at genetic level. In case of fodder yield per plant positive and significant correlation were observed with effective tiller at basal, dry earhead weight, day to 50% flowering and plant height (Table 5).

The genotypic path result (Table 6) revealed that positive highest direct effect of day to 50% flowering (0.98) followed by fodder yield and test weight. Where as plant height and days to maturity showed negative direct effect for grain yield of bajra.

The result of regression analysis (Table7) indicated that the positive highest contribution was given by dry earhead weight followed by fodder weight and test weight, while negative contribution was observed for plant height and earhead length for grain yield of bajra.

The phenotypic correlations revealed that tillers plant^{-1} and grains spike^{-1} were highly positively associated; hence these yield components can be used as reliable selection criteria to improve grain yield in wheat. Thus estimation of correlation and regression analysis among yield and yield components may provide effective selection criteria to improve wheat grain yield. The results from correlation and regression of plant height indicated significantly positive association with spikelet's spike^{-1}, tillers plant^{-1} and grains spike^{-1} which revealed that increase in plant height will cause corresponding increase in associated traits. (Bhutto. et. al., 2016)

Comparison of results obtained by different methods viz., factor analysis, genotypic correlations and its path analysis and regression analysis using same set of data to identify the yield contributing characters is presented in Table 8. The results of average of rank indicated that days to 50% flowering was the important characters identified by all the methods.

Table 1 : First and second degree statistics for different characters of Bajra.

Variable	Mean	Std Dev	Coeff of Variation	Minimum	Maximum	Range Coefficient
GYP (gm plant^{-1})	34.8	7.8	22.3	17.3	49.2	0.48
FYP (gm plant^{-1})	81.0	18.8	23.2	52.0	132.1	0.43
DEHW (gm plant^{-1})	58.4	8.8	15.1	46.7	76.3	0.24
ETB (no.)	3.4	0.8	24.5	1.8	5.2	0.49
EHG (cm)	9.2	1.1	11.5	6.8	13.2	0.32
EHL(cm)	24.5	4.2	17.3	17.5	36.8	0.36
PH(cm)	166.5	13.6	8.2	135.0	200.0	0.19
DM (no.)	84.0	1.9	2.3	80.0	89.0	0.05
DF(no.)	45.8	2.5	5.5	40.0	50.0	0.11
TWT (gm)	7.6	0.7	9.6	5.8	9.2	0.23

Table 2 : Eigen values of the Correlation Matrix (Total=9, Average=1)

Sr.No.	Value	ence	rtion	ılative
FYP	2.63	-	0.29	0.29
DEHW	1.87	0.75	0.21	0.50
ETB	1.11	0.77	0.12	0.62
EHG	0.92	0.19	0.12	0.73
EHL	0.68	0.24	0.08	0.8
PH	0.58	0.10	0.06	0.87
DM	0.51	0.07	0.06	0.92
DF	0.43	0.08	0.05	0.97
TWT	0.27	0.15	0.03	1

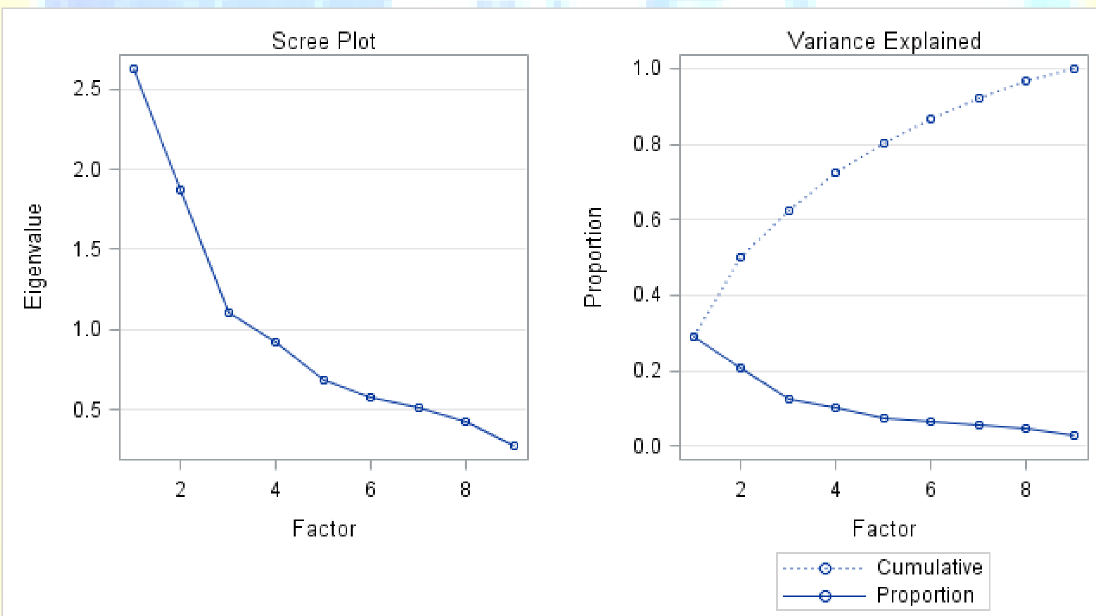

Fig.1 : Scree plot and variance distribution

Table 3 : First factor pattern and final communality of different characters in Bajra.

Character	Factor 1	Factor 2	Factor 3	Communality
FYP	0.74	0.03	0.20	0.59
DEHW	0.59	-0.29	0.14	0.45
ETB	0.32	-0.41	0.35	0.39
EHG	0.30	0.74	0.24	0.69
EHL	-0.10	0.77	0.24	0.66
PH	0.71	0.29	0.18	0.62
DM	0.49	-0.04	-0.73	0.79
DF	0.80	-0.32	0.03	0.73
TWT	0.38	0.54	-0.48	0.67
Variance explained	2.63	1.87	1.11	5.61
Variance explained %	29.2	20.8	12.3	-

Table 4 : Factor loading (Rotated) for different characters in Bajra.

acter	r 1	r 2	r 3
FYP	0.72	0.24	0.14
DEHW	0.66	-0.11	0.05
ETB	0.53	-0.19	-0.28
EHG	0.12	0.82	0.10
EHL	-0.25	0.77	-0.06
PH	0.60	0.47	0.21
DM	0.21	-0.20	0.84
DF	0.82	-0.13	0.23
TWT	0.01	0.40	0.71
Variance explained	2.38	1.81	1.42
Variance explained %	26.4	20.1	15.8

Cumulative %	26.4	46.5	62.3

Table 5 : Genotypic correlation coefficients between different characters in Bajra

Character	GYP	FYP	DEHW	ETB	EHG	EHL	PH	DM	DF	TWT
GYP	1.00	0.67**	0.79**	0.81**	-0.02	-0.29	0.09	0.46	0.72**	0.36
FYP		1.00	0.47*	0.58**	0.30	-0.06	0.69**	0.26	0.63**	0.19
DEHW			1.00	1.30**	-0.01	-0.20	0.15	0.30	0.71**	0.01
ETB				1.00	-0.28	-0.34	0.20	0.08	0.69**	-0.07
EHG					1.00	0.63**	0.53*	-0.08	0.15	0.42
EHL						1.00	0.19	-0.16	-0.38	0.22
PH							1.00	0.21	0.54*	0.32
DM								1.00	0.37	0.38
DF									1.00	0.07
TWT										1.00

* , ** indicates significant at 5 and 1 % level of significance

Table 6 : Matrix of direct and indirect effects of different characters on grain yield of Bajra.

Character	FYP	DEHW	ETB	EHG	EHL	PH	DM	DF	TWT
FYP	**0.874**	-0.021	-0.009	-0.102	-0.024	-0.744	-0.017	0.615	0.103
DEHW	0.409	**-0.045**	-0.019	0.004	-0.081	-0.156	-0.02	0.695	0.007
ETB	0.505	-0.059	**-0.015**	0.098	-0.138	-0.215	-0.005	0.673	-0.04
EHG	0.258	0.001	0.004	**-0.346**	0.251	-0.571	0.006	0.144	0.231
EHL	-0.053	0.009	0.005	-0.216	**0.401**	-0.203	0.011	-0.368	0.12
PH	0.602	-0.007	-0.003	-0.183	0.075	**-1.080**	-0.014	0.528	0.178
DM	0.223	-0.013	-0.001	0.028	-0.062	-0.226	**-0.068**	0.362	0.212
DF	0.548	-0.032	-0.01	-0.051	-0.15	-0.581	-0.025	**0.98**	0.039
TWT	0.162	-0.001	0.001	-0.144	0.087	-0.346	-0.026	0.068	**0.555**

Table 7 : Regression coefficients and SPRC for different characters of Bajra.

Model	Partial regression coefficients		Test of Significance		SPRC
	(b)	Std. Error	(t)	(P)	(b)
Constant	-36.306	33.851	-1.073	0.288	-
FYP	0.131	0.047	2.780	0.008	0.316
DEHW	2.237	0.612	3.653	0.001	0.372
ETB	0.270	0.924	0.292	0.771	0.029
EHG	1.023	0.825	1.241	0.220	0.139
EHL	-0.299	0.204	-1.464	0.149	-0.163
PH	-0.200	0.067	-2.982	0.004	-0.352
DM	0.266	0.429	0.620	0.538	0.065
DF	0.790	0.406	1.947	0.057	0.257
TWT	2.297	1.128	2.036	0.047	0.215

Dependent Variable: grain yield per plant

Table 8 : Comparison of results obtained by different methods.

Characters	Ranks				Average	S D
	Factor (h^2)	Correlation	Path	Regression		
FYP	7	4	2	2	3.75	2.36

DEHW	8	2	6	1	4.25	3.30
ETB	9	1	5	7	5.50	3.42
EHG	3	8	8	5	6.00	2.45
EHL	5	9	4	8	6.50	2.38
PH	6	7	9	9	7.75	1.50
DM	1	5	7	6	4.75	2.63
DF	2	3	1	3	2.25	1.29
	4	6	3	4	4.25	1.41

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