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QUALITY IMPROVEMENT OF LITTLE MILLET (*Panicum sumatrense* L.) THROUGH INTERRELATIONSHIP STUDIES BETWEEN YIELD AND QUALITY TRAITS

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ABSTRACT

Association study was conducted using 32 genotypes of little millet (*Panicum sumatrense* L.) for sixteen different morphological and quality traits. This study revealed that, grain yield per plant showed highly significant and positive correlation with days to 50 % flowering, plant height at maturity, number of tillers per plant, panicle length, straw yield per plant, days to maturity, protein content at both genotypic and phenotypic levels while, iron content had highly significant positive correlation with grain yield per plant at genotypic level. Thus, selection practiced for the improvement in one trait will automatically result in improvement of other trait even through direct selection. On the basis of present investigation of interrelationship, it can be presumed that for improvement of quality characters such as for improving protein content, the characters *viz*., days to 50 % flowering, plant height at maturity, number of productive tillers per plant, number of branches per panicle, panicle length, grain yield per plant, straw yield per plant and days to maturity; for improving ash content, the character fiber content; for improving iron content, the character number of productive tillers per plant, panicle length and protein content are ideal characters are ideal characters. The characters number of branches per plant, ash content and fiber content exhibited negative correlation with grain yield per plant indicates, for the improvement of quality traits at the cost of yield penalty. Hence, these characters could be utilized as selection criteria for improving quality characters.

Key words : *Little millet, association study, quality and yield traits.*

Small millets widely known as 'nutricereals' consist a number of distinct species of small-seeded grasses that are grown for grain purpose, each with their own unique traits and very good nutritional value. The most economically significant of these at present is finger millet, but the other small millets like little millet, barnyard millet, proso millet, foxtail millet, and kodo millet are also have their own importance to the tribal farmers who grow them (1).

Little millet belongs to the family Poaceae, sub-family Panicoideae and the tribe Paniceae (2). Little millet was domesticated in the Eastern Ghats of India occupying a major portion of diet amongst the tribal people and spread to Sri Lanka, Nepal, and Myanmar (De Wet et al.). Little millet (*Panicum sumatrense* L.) is grown in India under various agro-ecological situations and commonly known as samai, samo, moraio, vari, kutki. India is well known for its rich agro-biodiversity and prime contributor with 473 accessions (3). In India, little millet having 1.42 lakh tones of production. In Gujarat, little millet is cultivated in an area of 10,634 hectares with 9,526 tonnes of production having the productivity of 896 kg/ha (4). The area under this crop is mainly concentrated in the districts of The Dangs, Valsad, Navsari of South Gujarat and Panchmahal of middle Gujarat.

Little millet is a hardy crop which can withstand drought better than most of other cereal crops and water logging to a certain degree, also. Besides India, it is cultivated in Nepal and Western Burma. The potentiality of little millet has not been exploited in India and the yield levels are very low there by indicating a greater scope for exploitation of this millet under Indian condition. In India, little millet growing states are Karnataka, Tamil Nadu, Odisha, Madhya Pradesh, Chhattisgarh, Jharkhand, Andhra Pradesh, Uttarakhand, Maharashtra and Gujarat. In Gujarat, generally little millet crop is grown in hilly tract of Dangs and Valsad district and locally known as "Vari or Moraio". The productivity of little millet is low due to poor soil fertility and age-old cultivation methods.

Yield is a complex character and dependent on many component traits. Hence, it is necessary to have knowledge on the extent of association between yield and yield contributing characters. Therefore, correlation studies are of considerable importance in any selection programmes as they provide relationship between two or more component characters. Hence, the present experiment was conducted to study the phenotypic and genotypic association between yield and quality characters.

MATERIALS AND METHODS

The experiment was conducted at Hill Millet Research Station, Navsari Agricultural University, Waghai (The Dangs) using 32 genotypes of little millets in randomized block design with three replications. The gross plot is divided into three blocks which were taken as a replications while the blocks are further divided into equal 32 plots. Five randomly selected plants from each genotype in each replication were used to record observations for morphological characters. Data were recorded on total 16 morphological and biochemical traits

viz., days to 50 % flowering, days to maturity, zinc content (mg), plant height at maturity (cm), 1000 seed weight (g), fiber content (%), number of productive tillers per plant, number of branches per panicle, panicle length (cm), grain yield per plant(g), straw yield per plant (g) and quality traits *viz;* protein content (%), ash content (%), fat content (%), calcium content (mg), iron content (mg).

Correlation coefficients measure the relationship between two or more series of variables. The genotypic correlation coefficient provides a measure of genotypic association between different characters, while phenotypic correlation includes both genotypic as well as environmental influences. The mean of five plants was subjected to statistical analysis, data were statistical analyzed to estimate phenotypic, genotypic and environmental correlation coefficients were estimated by applying the procedure outlined by Falconer (1981). Prior to calculating the correlation coefficients, the analysis of co-variance for all the possible pairs of the characters under investigation was carried out using the procedure described by (5).

RESULTS AND DISCUSSION

Correlation coefficient is a statistical measure which is used to find out the degree and direction of relationship between two or more variable. Thus correlation measures the natural relationship between two or more variable. Phenotypic and genotypic correlations were worked out on yield and yield contributing characters in 32 genotypes. The results of present study, which revealed comparative higher degree of genotypic correlation coefficients than their phenotypic counterparts in most of the characters, indicated that there was a higher degree of association between two characters of genotypic association, their phenotypic association was lessened due to the influence of environment (6). However, in few cases, the phenotypic correlation was slightly higher than their genotypic counterparts, which implied that the non genetic cause inflated the value of genotypic correlation because of the influence of the environmental factors.

In the present investigation, grain yield per plant was found to be highly significant and positively correlated with days to 50% flowering (r_g = 0.84 and r_p = 0.72), plant height at maturity (r_g = 0.71 and r_p = 0.53), number of productive tillers per plant (r_g = 0.57 and r_p = 0.53), panicle length (r_g = 0.69 and r_p = 0.56), straw yield per plant (r_g = 0.48 and r_p = 0.42), days to maturity (r_g = 0.50 and r_p= 0.39), protein content (r_g = 0.66 and r_p = 0.57) at both genotypic and phenotypic levels and iron content (r_g = 0.28) had positive highly significant correlation with grain yield per plant at genotypic level indicating that these attributes were mainly influencing the grain yield in little millet, while It possessed positive non significant correlation at both genotypic and phenotypic level with zinc content (r_g = 0.06 and r_p = 0.07). It had negative non significant correlation with calcium content, fat content and 1000 grain weight at both genotypic and phenotypic level. It possessed negative highly significant correlation at genotypic and phenotypic level for fiber content (rg= -0.51 and r_p = -0.48), while at phenotypic level with ash content (r_p = -0.34). Similar results exhibiting positive highly significant correlation between grain yield and other traits as obtained in the present investigation were also reported by (7) for grain yield with days to maturity, number of tillers per plant, length of panicle and straw yield, (8) for grain yield with days to 50% flowering, plant height, length of panicle, straw yield per plant, days to maturity; (9) for grain yield with days to 50 % flowering, plant height and number of productive tillers (r_g); (10) for grain yield with panicle length (r_p); (11) for grain yield with days to heading, plant height, length of panicle, straw yield (r_p); (12) for grain yield with number of tillers per plant (r_g) and (13) for grain yield with panicle length and number of productive tillers per plant at both genotypic and phenotypic level in little millet while (14) for grain yield with plant height, productive tillers and straw yield per plant; (14) for grain yield with days to 50 % flowering and days to maturity at both genotypic and phenotypic level; (15) for grain yield with days to flowering, days to maturity, number of productive tillers, plant height, and finger length; (15) for grain yield with number of productive tillers per plant; (16) for grain yield with productive tillers (r_g, r_p); (16) for grain yield with days to maturity, number of productive tillers per plant and main ear head length; (17) for grain yield with plant height and number of productive tillers per plant at genotypic level; (9) for grain yield with days to 50% flowering, panicle length, number of productive tillers per plant, plant height (r_g); (9) for grain yield with plant height and finger length at both genotypic and phenotypic level; (9) for grain yield with number of productive tillers per plant; (9) for grain yield with number of productive tillers per plant, finger length, 1000 seed weight (r_p); for grain yield with plant height, finger length, number of productive tillers per plant, days to 50% flowering and days to maturity (r_p); (18) for grain yield with straw yield, number of productive tillers per plant, main earhead length and protein content at both genotypic and phenotypic levels; (19) for grain yield with days to maturity and number of productive tillers per plant at genotypic level in minor millets.

Days to 50% flowering showed positive highly significant correlation at both genotypic and phenotypic levels with plant height at maturity (r_g = 70 and r_p = 0.41), number of productive tillers per plant (r_g = 0.42 and r_p = 0.35), panicle length (r_g = 0.71 and rp= 0.52), grain yield per plant (r_g = 0.84 and r_p = 0.72), straw yield per plant (r_g = 0.61 and r_p = 0.53), days to maturity (r_g = 0.67 and r_p= 0.52), protein content (r_g = 0.75 and r_p = 0.58). It had

negative non significant correlation with the characters like number of branches per panicle, 1000 grain weight, fat content, calcium content while, non significant positive correlation with zinc content. It showed ash content (r_g = -0.42 and rp= -0.37) and fiber content (r_g = -0.46 and r_p = -0.42) showed negative highly significant correlation at both the level with while, iron content showed positive significant correlation at genotypic level (r_g = 0.22) and positive non significant correlation at phenotypic level (r_p = 0.19). Similar results were found by (8) for days to 50% flowering with plant height, length of panicle, grain yield per plant, straw yield per plant, days to maturity; (9) for days to 50% flowering with number of productive tillers per plant (r_g); for days to 50% flowering with plant height (r_p); (12) for days to 50% flowering with days to maturity, number of productive tillers per plant (r_g) and (13) for days to 50% flowering with days to maturity at both genotypic and phenotypic level in little millet, while Abraham (1989) for days to 50% flowering with days to maturity at both genotypic and phenotypic level; (13) for days to 50% flowering with plant height and length of panicle at both genotypic and phenotypic level; (9) for days to 50% flowering with plant height and panicle length (rg); (16) for days to 50 % flowering with plant height, days to maturity at both genotypic and phenotypic level; (17) for days to 50% flowering with 1000 seed weight at both genotypic and phenotypic level in finger millet; (17) for days to 50% flowering with plant height (rg); (17) for days to 50% flowering with plant height, finger length, number of productive tillers per plant (r_p); (18) for days to 50% flowering with days to maturity and protein content at both genotypic and phenotypic level; (19) for days to 50% flowering with 1000 seed weight in other small millets.

Plant height had positive highly significant correlation with traits viz., grain yield per plant (r_g = 0.71 and r_p = 0.53), length of panicle (r_g = 0.52 and r_p = 0.32), straw yield (r_g = 0.49 and r_p = 0.35), protein content (r_g = 0.33 and r_p = 0.20) at both genotypic and phenotypic levels while, positive highly significant correlation at genotypic level (r_g = 0.272) and positive and significant positive correlation at phenotypic level (r_p = 0.25) with days to maturity. It had positive significant correlation at genotypic level (r_g = 0.20) and positive non significant correlation at phenotypic level (r_p = 0.13) with zinc content, while positive non significant correlation with number of productive tillers per plant (r_g = 0.19 and r_p = 0.12), fat content (r_g = 0.082 and r_p = 0.10) and iron content (r_g = 0.16 and r_p = 0.14) at both genotypic and phenotypic level. It had negative highly significant correlation with 1000 grain weight (r_g = -0.64 and r_p = -0.52) at both genotypic and phenotypic level, while negative highly significant correlation at genotypic level (r_g = -0.307) and negative significant correlation at phenotypic level (r_p = -0.21) with number of branches per panicle. It had negative non significant correlation with ash content (r_g = -0.06 and r_p = -0.02), calcium content (r_g = -0.18 and r_p = -0.14) and fiber content (r_g = -0.12 and r_p = -0.10) at both genotypic and phenotypic level. Similar results were found by (8) for plant height with days to 50 % flowering, length of panicle, grain yield per plant, straw yield per plant and days to maturity; (17) for plant height with length of panicle at both genotypic and phenotypic level and (10) for plant height with length of panicle, 1000 seed weight and single plant dry matter (r_p) in little millet, while (14) for plant height with ear length and straw yield per plant in finger millet; (9) for plant height with panicle length (r_g) in foxtail millet and (9) for plant height with finger length, days to maturity (r_p) in finger millet; (18) for plant height with protein content and (19) for plant height with 1000 seed weight.

Number of productive tillers per plant had positive highly significant correlation with trait grain yield per plant (r_g = 0.57 and r_p = 0.53), iron content (r_g = 0.31 and r_p= 0.27), protein content (r_g = 0.55 and r_p = 0.47) and days to maturity (r_g = 0.63 and r_p = 0.58) at both genotypic and phenotypic levels. It had positive significant correlation with fat content (r_g = 0.25 and r_p = 0.22) at both the level genotypic and phenotypic. It had positive highly significant correlation at genotypic level (r_g = 0.28) and significant positive correlation at phenotypic level (r_p = 0.26) with 1000 grain weight. It had positive significant correlation at genotypic level (r_g = 0.20) and non significant positive correlation at phenotypic level (r_p = 0.13) with number of branches per panicle. It had positive non significant correlation at genotypic level and phenotypic level for length of panicle (r_g = 0.12 and r_p = 0.12), straw yield (r_g = 0.17 and r_p = 0.15), calcium content (r_g = 0.07 and r_p = 0.06), zinc content (r_g = 0.07 and r_p = 0.06). It had negative highly significant correlation at genotypic level and phenotypic level for ash content (r_g = -0.35 and r_p = -0.32) and fiber content (r_g = -0.42 and r_p = -0.37). Similar results were found by (19) for number of productive tillers per plant with days to maturity and main ear head length; (19) for number of productive tillers per plant with days to maturity (r_p) and (18) for number of productive tillers per plant with protein content and iron content.

Panicle length possessed positive non significant correlation with number of productive tillers per plant (r_g = 0.12 and r_p = 0.12), days to maturity (r_g = 0.01 and r_p = 0.02), zinc content (r_g = 0.14 and r_p = 0.10) at both genotypic and phenotypic level. It had positive highly significant correlation at genotypic level and phenotypic level with iron content (r_g = 0.38 and r_p = 0.29). It had positive highly significant correlation at genotypic level with protein content (r_g = 0.30). It had positive highly significant correlation at genotypic level (r_g = 0.27) and positive non significant correlation at phenotypic level (r_p =

Table-1 : Genotypic phenotypic correlation coefficient for sixteen characters in thirty-two genotype of little millet.

Traits		DF	PH	NOT	NOB	PL	GY	SY	DM	TW	PR	ASH	FAT	Ca	Fe	Zn	FIB
DF	rg	1.00	0.70**	0.42**	-0.10 NS	0.71**	0.84 **	0.61 **	0.67 **	-0.04 NS	0.75**	-0.42**	-0.11NS	-0.15 NS	0.22*	0.03NS	-0.466**
	rp		0.41**	0.35**	-0.01NS	0.52**	0.72**	0.53**	0.52**	-0.05NS	0.58**	-0.37**	-0.10NS	-0.13NS	0.19NS	0.02NS	-0.42**
PH	rg		1.00	0.19NS	-0.30 **	0.52**	0.71**	0.49**	0.27**	-0.64**	0.33**	-0.06NS	0.08NS	-0.18NS	0.16NS	0.20*	-0.12NS
	rp			0.12NS	-0.21*	0.32**	0.53**	0.35**	0.25*	-0.52**	0.20*	-0.02NS	0.10NS	-0.14NS	0.14NS	0.13NS	-0.10NS
NOT	rg			1.00	0.20*	0.12NS	0.57**	0.17NS	0.63 **	0.28**	0.55**	-0.35**	0.25*	0.07NS	0.31**	0.07NS	-0.42**
	rp				0.13NS	0.12NS	0.53**	0.15NS	0.58**	0.26*	0.47**	-0.32**	0.22*	0.06NS	0.27**	0.06NS	-0.37**
NOB	rg				1.00	-0.60**	-0.24*	0.14 NS	0.66 **	0.51**	0.39**	-0.02NS	0.25*	-0.15NS	-0.12NS	-0.28**	0.002NS
	rp					-0.42**	-0.18NS	0.15NS	0.37**	0.39**	0.21*	0.02NS	0.15NS	-0.10NS	-0.09NS	-0.20NS	-0.01NS
PL	rg					1.00	0.69**	0.27**	0.01NS	-0.27**	0.30**	-0.29**	-0.14NS	-0.014NS	0.38**	0.14NS	-0.45**
	rp						0.56**	0.18NS	0.02NS	-0.21*	0.23*	-0.22*	-0.13NS	-0.02NS	0.29**	0.10NS	-0.38**
GY	rg						1.00	0.48**	0.50**	-0.11NS	0.66**	-0.38**	-0.01NS	-0.15NS	0.28**	0.06NS	-0.51**
	rp							0.42**	0.39**	-0.11NS	0.57**	-0.34**	-0.004NS	-0.13NS	0.24*	0.07NS	-0.48**
SY	rg							1.00	0.51**	-0.04NS	0.68**	-0.26**	0.06NS	-0.27**	0.10NS	0.04NS	-0.32**
	rp								0.41**	-0.05NS	0.54**	-0.21*	0.07NS	-0.24*	0.09NS	0.02NS	-0.27**
DM	rg								1.00	0.32**	0.74**	-0.17NS	0.23*	-0.13NS	0.03NS	0.01NS	-0.27**
	rp									0.24*	0.54**	-0.16NS	0.16NS	-0.11NS	0.04NS	-0.007NS	-0.23*
TW	rg									1.00	0.15NS	-0.27**	-0.08NS	0.20*	-0.09NS	-0.30**	-0.04NS
	rp										0.11NS	-0.24*	-0.08NS	0.18NS	-0.09NS	-0.28**	-0.05NS
PR	rg										1.00	-0.41**	0.08NS	-0.34**	0.36**	-0.02NS	-0.53**
	rp											-0.32**	0.09NS	-0.29**	0.30**	-0.02NS	-0.45**
ASH	rg											1.00	0.15NS	0.10NS	0.036NS	0.02NS	0.51**
	rp												0.15NS	0.096NS	0.028NS	0.016NS	0.48**
FAT	rg												1.00	0.005NS	-0.04NS	-0.007NS	0.009NS
	rp													0.0009NS	-0.045NS	-0.019NS	0.01NS
CA	rg													1.00	0.007NS	-0.14NS	0.12NS
	rp														-0.008NS	-0.13NS	0.11NS
FE	rg														1.00	0.25*	-0.24*
	rp															0.23*	-0.21*
ZN	rg															1.00	-0.002NS
	rp																0.01NS
FIB	rg																1.00
	rp																

Where…

DF = Days to fifty % flowering
PH = Plant height at maturity (cm)
NOT = Number of productive tillers per plant
TW = 1000 seed weight (g)
GY = Grain yield per plant (g)
SY = Straw yield per plant (g)
DM = Days to maturity
Fe = Iron content (mg)
ASH = Ash content (%)
FAT = Fat content (%)
Ca = Calcium content (mg)
PL = Panicle length (cm)
Zn = Zinc content
FIB = Fiber content (%)
NOB = Number of branches per panicle
PR = Protein content (%)

0.18) with straw yield. It had negative highly significant correlation with fiber content (r_g = -0.45 and r_p = -0.38) at both genotypic and phenotypic level, while negative highly significant correlation at genotypic level and negative significant correlation at phenotypic level with 1000 grain weight (r_g = -0.27 and r_p = -0.21) and ash content (r_g = -0.29 and r_p = -0.22). It had negative non significant correlation with fat content (r_g = -0.14 and r_p = -0.13) and calcium content (r_g = - 0.014 and r_p = - 0.02) at both genotypic and phenotypic level. Similar results were found by Anuradha *et al*. for panicle length with days to maturity (18) for panicle length with protein content.

Straw yield had positive highly significant correlation with protein content (r_g= 0.68 and r_p= 0.54) and days to maturity (r_g= 0.51 and r_p= 0.41) at both genotypic and phenotypic levels. It had positive non significant correlation with iron content (rg= 0.10 and rp= 0.09), fat content (r_g= 0.06 and r_p= 0.07) and zinc content (r_g= 0.042 and r_p= 0.02) genotypic and phenotypic level. It had negative highly significant correlation at genotypic level and phenotypic level for fiber content (r_g= -0.32 and r_p= -0.27), while negative non significant correlation with 1000 grain weight (r_g= -0.045 and r_p= -0.05) at genotypic and phenotypic level. It had negative highly significant correlation at genotypic level and negative significant correlation at phenotypic level for ash content (r_g= -0.26 and r_p= -0.21) and calcium content (r_g= -0.27 and r_p= -0.24). Similar results were found by (18) for straw yield with protein content.

Days to maturity had positive highly significant correlation with protein content at both genotypic and phenotypic levels (r_g= 0.74 and r_p= 0.54). It had positive highly significant correlation at genotypic level (r_g= 0.32) and positive significant correlation at phenotypic level (r_p= 0.24) with 1000 grain weight. It had positive significant correlation at genotypic level (r_g= 0.23) and positive non significant correlation at phenotypic level (r_p= 0.16) with fat content. It had positive non significant correlation with iron content (r_g= 0.03 and r_p= 0.04) at both genotypic and phenotypic level. It had positive non significant correlation at genotypic level (r_g=0.01) and negative non significant correlation at phenotypic level (r_p= -0.007) with zinc content. It had negative highly significant correlation at genotypic level (r_g= -0.27) and negative significant correlation at phenotypic level (r_p= -0.23) with fiber content. It had negative non significant correlation at genotypic and phenotypic level for ash content (r_g= -0.17 and r_p= -0.16) and calcium content (r_g= -0.13 and r_p= -0.11). Similar findings were found by (18) for days to maturity with protein content and iron content, (20) for protein content and (19) for days to maturity with 1000 seed weight.

The 1000 seed weight had positive significant correlation at genotypic level (r_g= 0.20) and positive non significant correlation at phenotypic level (r_p= 0.18) correlation with calcium content, while positive non significant correlation at genotypic and phenotypic level with protein content (r_g= 0.15 and r_p= 0.11). It show negative highly significant correlation at genotypic and phenotypic level with zinc content (r_g= -0.30 and r_p= -0.28), while negative highly significant correlation at genotypic level (r_g= -0.27) and negative significant correlation at phenotypic level (r_p= -0.24) with ash content. It had negative non significant correlation at genotypic and phenotypic level with fat content (r_g= -0.08 and r_p= -0.08), iron content (r_g= -0.09 and r_p= -0.09) and fiber content (r_g= -0.044 and r_p= -0.05).

Protein content showed positive highly significant correlation with iron content (r_g= 0.36 and r_p= 0.30) at genotypic and phenotypic level, while positive non significant correlation at both genotypic and phenotypic level with fat content (r_g= 0.08 and r_p= 0.09). It had negative highly significant correlation at genotypic and phenotypic level with ash content (r_g= -0.41 and r_p= -0.32), calcium content (r_g= -0.34 and r_p= -0.29) and fiber content (r_g= -0.53 and r_p= -0.45). It had negative non significant correlation with zinc content. Similar results are in agreement with (18) for protein content with iron content (r_g) in finger millet.

Ash content showed positive highly significant correlation with fiber content (r_g= 0.51 and r_p= 0.48) at genotypic and phenotypic level, while positive non significant correlation at both genotypic and phenotypic level with fat content (r_g= 0.15 and r_p= 0.15), calcium content (r_g= 0.10 and r_p= 0.096), iron content (r_g= 0.036 and r_p= 0.028) and zinc content (r_g= 0.02 and r_p=0.016).

Fat content showed negative non significant correlation at genotypic and phenotypic level with iron content (r_g= -0.04 and r_p= -0.04) and zinc content (r_g= -0.007 and r_p= -0.019), while positive non significant correlation at genotypic and phenotypic level with calcium content (r_g= 0.005 and r_p= 0.0009) and fiber content (r_g= 0.009 and r_p= 0.01).

Calcium content showed negative non significant correlation at both genotypic and phenotypic level with zinc content (r_g= -0.14 and r_p=-0.13) while, positive non significant correlation at both genotypic and phenotypic level with fiber content (r_g= 0.12 and r_p= 0.11). It had positive non significant correlation at genotypic level (r_g= 0.007) and negative non significant correlation at phenotypic level (r_p= -0.008) with iron content.

Iron content showed positive significant correlation with zinc content (r_g= 0.25 and r_p= 0.23) at genotypic and phenotypic level, while negative significant correlation at

both genotypic and phenotypic level with fiber content (r_g= -0.24 and r_p= -0.21).

Zinc content showed negative non significant correlation at genotypic level (r_g= -0.002) and positive non significant correlation at phenotypic level (r_p= 0.015) with fiber content.

If the genetic correlation is high, the two characters can be regarded as being substantially the same and if there are no special circumstances affecting the intensity of selection, it will make little difference in which environment the selection is carried out (Falconer, 1981).

CONCLUSION

On the basis of present investigation of interrelationship, it can be presumed that for improvement of quality characters such as for improving protein content, the characters *viz*., days to 50 % flowering, plant height at maturity, number of productive tillers per plant, number of branches per panicle, panicle length, grain yield per plant, straw yield per plant and days to maturity; for improving ash content, the character fiber content; for improving iron content, the character number of productive tillers per plant, panicle length and protein content are ideal characters are ideal characters. The characters number of branches per plant, ash content and fiber content exhibited negative correlation with grain yield per plant indicates, for the improvement of quality traits at the cost of yield penalty. Hence, these characters could be utilized as selection criteria for improving quality characters.

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