Correlation Analysis for Agronomic and Fiber Quality Traits of Upland Cotton (*Gossypium hirsutum* L.) Genotypes under Irrigated Condition of Ethiopia

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ABSTRACT

Cotton breeders have faced the challenge of simultaneously improving yield and fiber quality traits. However, seed cotton yield must at least be maintained when improving fiber quality for a cultivar to remain competitive. The research work pertaining to the study of mean performance and correlation for agronomic and fiber quality traits during 2016 to 2018 at Werer Agricultural Research Center and Nasa-farm using RCBD with three replication among 12 cotton genotypes and 3 cotton checks variety. Analysis of variance manifested highly significant differences among the genotypes for all agronomic and fiber quality traits except average bolls weight and plant height. Genetic potential of fifteen cotton genotypes for different agronomic and quality traits were recorded. Highest mean value for seed

more characters may results from pleiotropic effects of genes or linkage of genes governing inheritance of two or more characters. While phenotypic correlation is association between two characters that observe and measure which the value is determined by genotypic value and environment deviation in which environmental correlation is a two variables comprises of correlation due to environmental traits and non-additive genetics causes [5]. Tallyta et al. also revealed that the estimates of genotypic, phenotypic and environmental correlations are indispensable for estimate the magnitude of the genetic variability of a population and the selection gains [6].

Correlation study is crucial asset to cotton breeders and determine the relationship between yield and quality characters or between the various factors contributing to seed cotton yield and lint yield. Khakwani et al. also reported that correlation is principal endeavor for cotton breeder to explore the relationship between yield and yield contributing attributes to boost up cotton seed and lint yield [7]. It also happens that due to character association, improvement in respect of one character may have been obtained at the expense of other in which increase in ginning outturn may result in the reduction of staple length and vice versa [8]. Early cotton research has revealed that seed cotton yield and fiber quality properties have strong negative associations due to genetic linkage, pleiotropy and various physiological reasons [9]. Baloch et al. also reported that for superiority of cotton varieties the associations of seed cotton yield with fiber quality and yield traits are indispensable [10]. Werer Agricultural Research Center under Ethiopian Institute of Agricultural Research has been making a maximum effort to develop high yielding varieties with better fiber qualities through the utilization of hybridization methods and selection technique

Data analysis

Data Analysis of variance was computed for all traits considering Randomized Complete Block Design (RCBD) as per Montgomery [12]. Phenotypic and genotypic correlation coefficients were computed using the method described by Miller et al. [13]. Analysis of variance, phenotypic and genotypic correlation was computed with SAS statistical software (9.3) [14]. The significance of mean differences was tested by least significant difference test $p \leq 0.05$ [LSD] as stated in Gomez and Gomez.

RESULTS

Analysis of variance

Results of analysis of variance of nine agronomic and quality traits are presented in Table 2. Mean squares for genotypes showed highly significant differences for all the traits except plant height and average bolls weight. This indicates that there is sufficient variability for the traits in the genotypes studied. On the hand, Genotypes x year interaction mean squares significantly different ($p \leq 0.01$) for ginning outturn, micronaire, fiber length and fiber strength while genotypes x location mean squares was significant for most important agronomic traits viz. seed cotton yield, lint yield and ginning outturn. The highly significant interaction term ($p \leq 0.01$), genotypes x environment (location and year) for the traits of seed cotton yield, ginning outturn and lint yield, and significant different for fiber length.

Table 2: Mean squares from combined analysis of variance for 9 phenotypic traits.

Traits	Genotypes (df=14)	Genotypes × year (df=28)	Location (df=14)	G × E Interaction (df=14)	Error (df=168)	CV (%)	R^2 (%)
Plant height(cm)	1681.48^{ns}	165.69^{ns}	157.01^{ns}	351.45^{ns}	198.1	12.76	73.74
Number of bolls per plant	1.73**	0.36^{ns}	0.18^{ns}	0.37^{ns}	0.38	11.98	47.43
Average bolls weight(gm)	19.97^{ns}	15.89^{ns}	12.03^{ns}	16.37 ^{ns}	14.36	19.55	78.8
Seed Cotton Yield(t/ha)	2.65**	0.87^{ns}	2.01**	1.25**	0.61	16.44	74.59
Ginning out turn (%)	56.56**	3.04**	2.35*	2.57**	1.24	2.94	88.33
Lint Yield(t/ha)	0.8**	0.11 ^{ns}	0.31**	0.17**	0.09	16.58	77.16
Micronaire	0.4**	0.16**	0.06 ^{ns}	0.09^{ns}	0.07	5.96	78.11
Fiber length(mm)	20.46**	2.26**	1.05^{ns}	0.99*	0.64	2.73	82.22
Fiber strength(g/tex)	23.7**	4.88**	3.22^{ns}	2.59^{ns}	2.33	5.29	87.01

Note: ns, * and **, non-significant, significant at P<0.05 and P<0.01, respectively, CV (%)=coefficient of variation in percent, df=Degree of freedom.

G4	97.03^{e}	18.65^{ab}	5.23^{bcde}	4.76^{a-e}	34.43^{h}	1.64^{ef}	4.37^{bcde}	27.63^{i}	27.23^{e}
G5	124.59								

bolls per plant. However, plant height had negative and non-significant phenotypic correlation to seed cotton yield, ginning outturn and lint yield. Average bolls weight showed positive and significant phenotypic association with fiber strength and seed cotton yield, while negatively and significant to ginning outturn and micronaire. Similarly, number of bolls per plant exhibited positive and significant phenotypic associations to all quality test traits namely, micronaire, fiber length and fiber strength. It has been observed negative and highly significant phenotypic associations in considerable pairs of fiber strength and ginning outturn. On other hand, the correlation between fiber length and fiber strength was positive and significant.

Table 4: Pair-wise genotypic (above diagonal) and phenotypic (below diagonal) correlation coefficients among 9 traits of 15 cotton genotypes evaluated at Werer and Nasa-farm, 2016-2018.

Traits	PH	ABW	NBPP	SCY	GOT	LY	M	FL	FS
PH	1	0.03ns	0.57*	0.03 ns	0.32 ns	0.14 ns	0.08 ns	0.71**	0.85**
ABW	0.31**	1	-0.52*	0.47 ns	0.42 ns	0.52*	0.56 *	-0.75**	-0.41 ns
NBPP	0.03 ns	-0.02 ns	1	0.35 ns	0.21 ns	0.30 ns	0.30 ns	0.43 ns	0.59*
SCY	-0.04 ns	0.20**	0.17**	1	0.65**	0.95**	0.87**	-0.34 ns	0.20 ns
GOT	-0.06 ns	-0.29**	-0.05 ns	0.16**	1	0.84**	0.72**	0.05 ns	0.45 ns
LY	-0.05 ns	0.12 ns	0.15*	0.97**	0.38**	1	0.89**	-0.23 ns	0.30 ns
M	-0.5**	-0.27**	0.21**	0.28**	0.25**	0.33**	1	-0.36 ns	0.14 ns
FL	0.4**	-0.1 ns	0.16**	-0.13*	-0.11 ns	-0.15*	-0.16**	1	0.7**
FS	0.3**	0.22**	0.14*	-0.27**	-0.27**	-0.30**	-0.01 ns	0.51**	1

Note: ns, *and**, non-significant, significant at p<0.05 and p<0.01, respectively. PH=plant height, NBPP=number of bolls per plant, ABW=average bolls weight, SCY(t ha^{-1})=seed cotton yield, GOT(%)=Ginning Outturn and LY(t ha^{-1})=Lint Yield, M=Micronaire, FL(mm)=Fiber Length and FS(g/tex)=Fiber Strength

Genotypic correlation of seed cotton yield and ginning outturn was positive but non-significant correlated with yield contributor namely, average bolls weight, plant height and number bolls per plant. The genotypic correlations among seed cotton yield, ginning outturn and micronaire were positive and highly significant. The genotypic correlation of lint yield has a positive and significant association with average bolls weight, seed cotton yield and ginning outturn but positively and non-significant correlated with plant height and number of bolls per plant. It is result from the result (Taof bnt yi± ﻫ u Γorr f lation ﻣﺠ eJ icai et u icr onair e

the highest seed cotton yield (5170.3 $kgha^{-1}$) and lint yield (2091.8 $kgha^{-1}$), respectively as Alehegn et al. revealed [17].

Significant and positive phenotypic correlation was observed between seed cotton yield and yield contributor agronomic traits like average bolls weight and number of bolls per plant while negatively correlated fiber length and fiber strength in which Zeng and Meredith studied for having found negative association between fiber length and seed cotton yield within intraspecific *G. hirsutum* populations [18]. Ganapathy et al. and Meena and Meena also stated that number of plant bolls per plant were positively associated with seed cotton yield per plant in simultaneous selection of number of bolls per plant will increase the seed-cotton yield automatically [19,20]. On the hand, lint yield positively correlated with number of bolls per plant and ginning outturn. Yield traits namely seed cotton yield and lint yield positive and significant genotypic correlations to ginning outturn and micronaire. Muhammad et al. revealed that the characters like plant height, number of bolls per plant, ginning outturn and fiber fineness had positive phenotypic association with agronomic and quality traits [21]. Similarly, significant positive association of seed cotton yield was observed

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