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Genetic Analysis of *Zea mays* Genotypes for Various Physiological and Plant Growth Related Traits to Improve Fodder Yield

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Abstract: For the assessment of correlation among fodder yield and its contributing traits an experiment was carried out in the research area of Department of Plant Breeding and Genetics, University of Agriculture Faisalabad, Pakistan during cropping seasons of 2011-12 and 2012-13. The genotypes B-316, EV-340, Pop/209, F-96, EV-347, B-322, Raka-poshi, B-327, Sh-139, B-336, B-11 and EV-1097 were selected on the basis of higher green fodder yield, leaf weight, leaf area, stem weight, leaf/stem ratio, photosynthetic rate, chlorophyll contents, water use efficiency and leaf temperature and crossed in 6 × 6 North Carolina matting design II. It was concluded that significant genotypic and phenotypic correlations were found high among chlorophyll contents, leaves per plant, plant height, leaf weight, stem weight, green fodder yield, leaf area and transpiration rate. It was suggested that selection of higher fodder yielding genotypes may be helpful to enhance crop yield and productivity.

Key words: *Zea mays* · Genotypic · Phenotypic · Correlation · Photosynthetic Rte · Chlorophyll Content

INTRODUCTION

Maize (*Zea mays*) is an essential cereal food crop throughout the world with great importance for emergent countries like Pakistan, where rapidly growing population has been effected the accessible food provisions. It is the third important cereal crop in Pakistan following to wheat and rice. The value of agriculture outputs has 5.67% contribution of maize. It was cultivated on 1083 thousands hectares with annual production of 4271 thousand tons and average yield of 3940 kg/ha [1]. Maize is used as food for human while feed for livestock and also used as an industrial raw material to produce a variety of types of by-products. It has highest 9.9% crude protein at early and at full blooming stages that lower down to 7% at milk stage (Grain formation stage) and to 6% at maturity. Its grain constitutes about 9.74 % grain protein, 4.85% grain oil, 9.44% grain crude fibre, 71.97% grain starch, 11.77% embryo while fodder contains 22.99% acid detergent fibre, 51.70% neutral detergent fibre, 28.80% fodder cellulose, 40.18% fodder dry matter, 26.85% fodder crude fibre, 10.35% fodder crude protein and 9.10% fodder moisture [2, 3]. The production of maize in Pakistan is lower as compared to other maize growing countries due to non-availability of funds and potential germplasm. Fodder yield of maize is associated with various morphological, physiological and agronomic traits. Improvement in these traits may be helpful in improvement of the fodder production of maize genotypes. Genotypic correlation

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provides a great prospect to a plant breeder to select genotypes on the basis of strong correlation among fodder yielding and its contributing traits [4-14]. The present study was conducted to evaluate maize accessions for morphological and physiological traits of maize for fodder yield.

MATERIALS AND METHODS

The present study was carried out in the experimental area of the Department of Plant Breeding and Genetics, University of Agriculture Faisalabad to assess the maize genotypes for fodder yielding traits for the interlude of the crop season in February 2011. The experimental material was comprising of 80 accessions including ten check varieties namely: F-150, F-111, F-105, F-121, F-130, F-134, F-135, F-117, B-326, BF-236, B-312, EV-344, E-352, F-148, E-341, B-304, F-143, F-113, F-122, B-316, EV-324, EV-335, EV-310, EV-323, B-121, E-336, E-351, F-142, EV-334, EV-330, EV-343, BF-248, EV-338, B-314, F-147, F-96, B-305, B-321, EV-342, EV-347, F-151, Pop/209, B-306, E-349, Sh-139, F-114, F-136, BF-212, B-308, F-118, F-140, F-128, F-146, B-303, B-327, B-303, B-313, F-98, B-96, BF-337, VB-06, BF-238, B-15, E-322, Sh-213, EV-329, EV-340, E-346, B-11, Pak-Afgoee, SWL-2002, EV-7004Q, EV-1097, Islamabad W, Raka-Poshi, Sawan-3, Gold Isalamabad, VB-51, BS-2 and Pop/2007.

The accessions were grown in the field following three replications in completely randomized block design. The plant-plant distance and row-row distance was kept 75 and 25cm, respectively. The data of 10 randomly selected plants was recorded for following traits, *viz*., stem diameter (cm) measured by Vernier Caliper (Model RS232), plant height (cm), leaf length (cm), leaf width (cm) and leaf area (cm^2) measured with the help of measuring meter rod, leaves weight (g), stem weight (g), green fodder yield (g) and leaf/stem weight ratio measured with the help of electronic balance (OHAUS-GT4000, USA), chlorophyll contents (mg g^{-1} fw) by using chlorophyll meter, photosynthetic rate (µg CO_2 s^{-1}), leaf temperature (°C), water use efficiency (%), stomata conductance (mmol m^{-2} s^{-1}), transpiration rate (mm day^{-1}) and sub-stomata CO_2 concentration (µmol mol^{-1} CO_2) by using IRGA (Infrared Gas Analyzer). Out of above 80 accessions twelve genotypes were selected on the basis of batter performance. The selected parents were crossed following 6 × 6 North Carolina matting design II during growing season of August 2011. The parents and F_1 crosses as given below and were evaluated in the field experiment for all above given traits during growing season of February 2012.

Sr. No.	Genotypes	Sr. No.	Genotypes	Sr. No.	Genotypes
1	Pop/209	17	B-11×F-96	33	B-327×EV-340
2	B-316	18	B-11×EV-347	34	B-327×E-322
3	EV-340	19	B-336×Pop/209	35	B-327×F-96
4	E-322	20	B-336×B-316	36	B-327×EV-347
5	F-96	21	B-336×EV-340	37	Raka-poshi×Pop/209
6	EV-347	22	B-336×E-322	38	Raka-poshi×B-316
7	B-11	23	B-336×F-96	39	Raka-poshi×EV-340
8	B-336	24	B-336×EV-347	40	Raka-poshi×E-322
9	EV-1097	25	EV-1097×Pop/209	41	Raka-poshi×F-96
10	B-327	26	EV-1097×B-316	42	Raka-poshi×EV-347
11	Raka-poshi	27	EV-1097×EV-340	43	Sh-139×Pop/209
12	Sh-139	28	EV-1097×E-322	44	Sh-139×B-316
13	B-11×Pop/209	29	EV-1097×F-96	45	Sh-139×EV-340
14	B-11×B-316	30	EV-1097×EV-347	46	Sh-139×E-322
15	B-11×EV-340	31	B-327×Pop/209	47	Sh-139×F-96
16	B-11×E-322	32	B-327×B-316	48	Sh-139×EV-347

The data was statistically analyzed by using analysis of variance technique [12]. The genotypic and phenotypic correlations were calculated by Kwon and Torrie [13] technique.

RESULTS AND DISCUSSION

It was suggested from the Fig. 1 that the highest chlorophyll contents were recorded for F-113 followed by B-303, while the lowest value of chlorophyll contents was F-98 followed by Pak-Afgoee. It was found from the Fig. 2 that the highest photosynthetic rate was recorded for F-151 followed by EV-335, while the lowest value of photosynthetic rate was B-11 followed by F-127. The higher photosynthetic rate also persuaded that the chlorophyll contents was increased that caused the increase in growth and development of crop plants [14,15]. It was suggested from the Fig. 3 that the highest stomata conductance was recorded for Pop-209 followed by F-155, while the lowest value of stomata conductance was EV-335 followed by Sh-139. The higher stomata conductance indicated higher photosynthetic rate and accumulation of organic compounds [16]. It was suggested from Fig. 4 that the highest leaf temperature was recorded for Sh-139 followed by Islamabad W, while the lowest value of leaf temperature was F-121 followed by F-127. The higher leaf temperature also persuaded that the chlorophyll contents are increased that caused the increase in growth and development of crop plants [9]. It was suggested from Fig. 5 that the highest transpiration rates were recorded for Pop-209 followed by EV-347, while the lowest value of transpiration rate was EV-335 followed by Sh-139. It was suggested from Fig. 6 that the highest sub-stomata CO_2 concentration was recorded for BF-236 followed by F-127 while the lowest value of sub-stomata CO_2 concentration was BF-248 followed by B-306. It was suggested from Fig. 7 that the highest water use efficiency was recorded for F-96 followed by Sh-213,

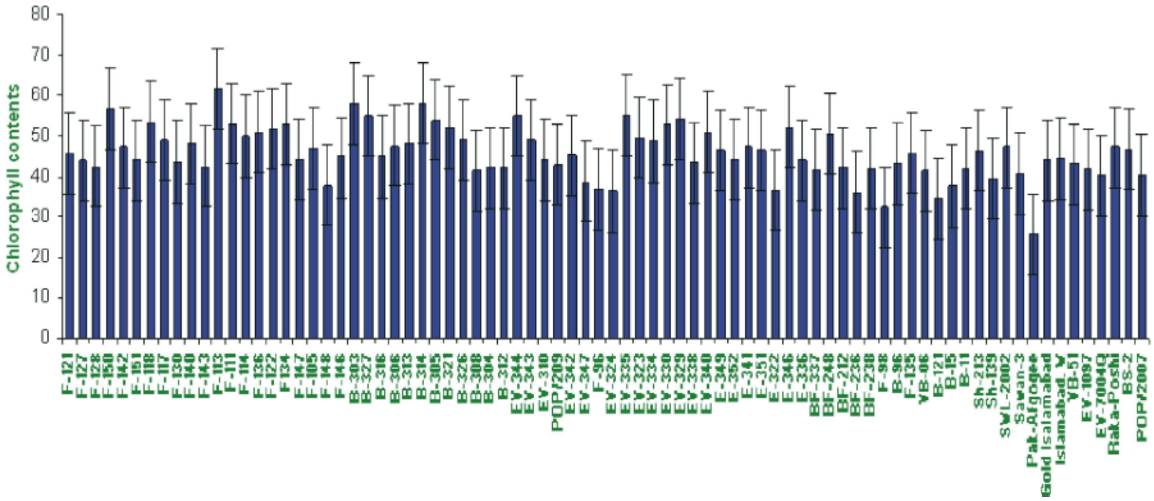

Fig. 1: Mean performance of maize accession for Chlorophyll contents (mg g^{-1} fr. wt.)

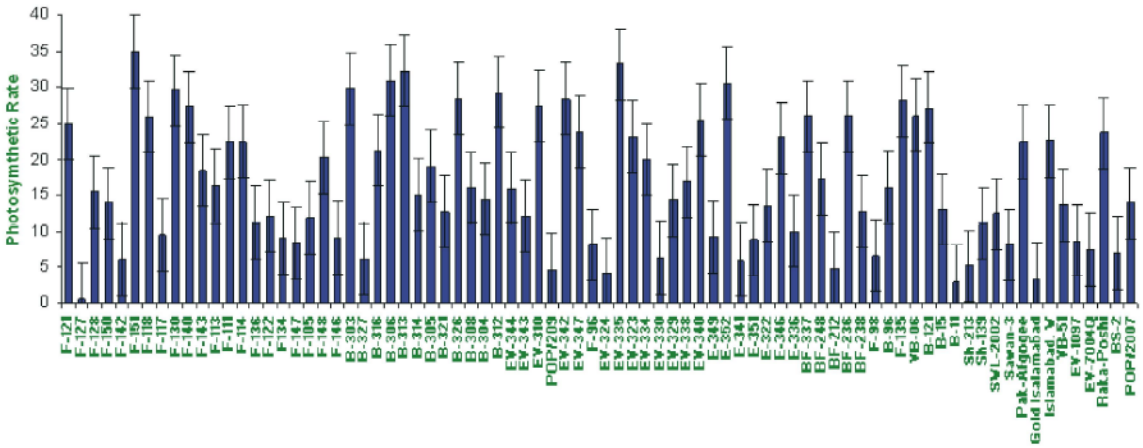

Fig. 2: Mean performance of maize accession for Photosynthetic rate (µg CO_2 s^{-1})

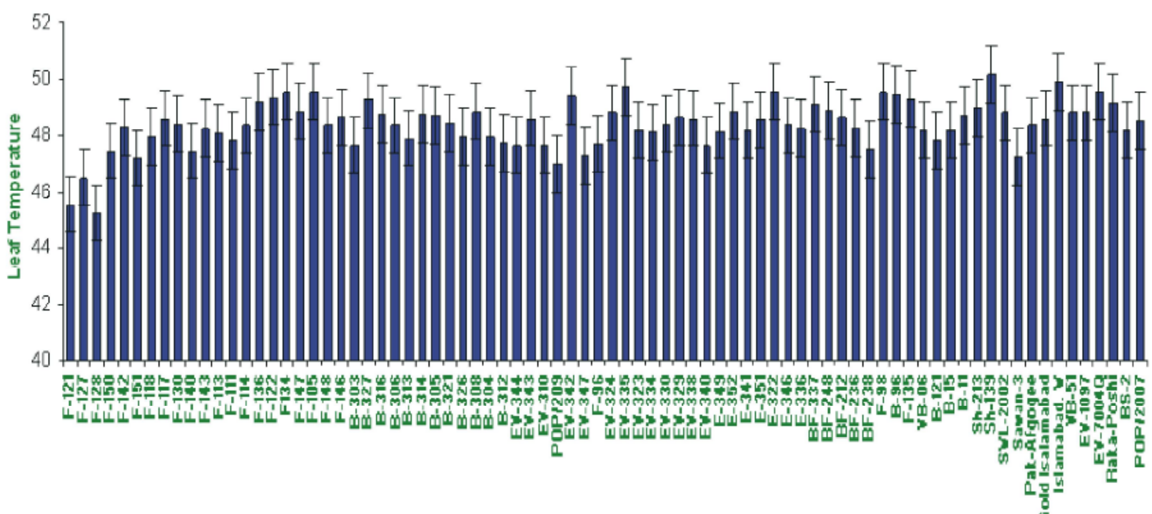

Fig. 3: Mean performance of maize accession for Leaf temperature (°C)

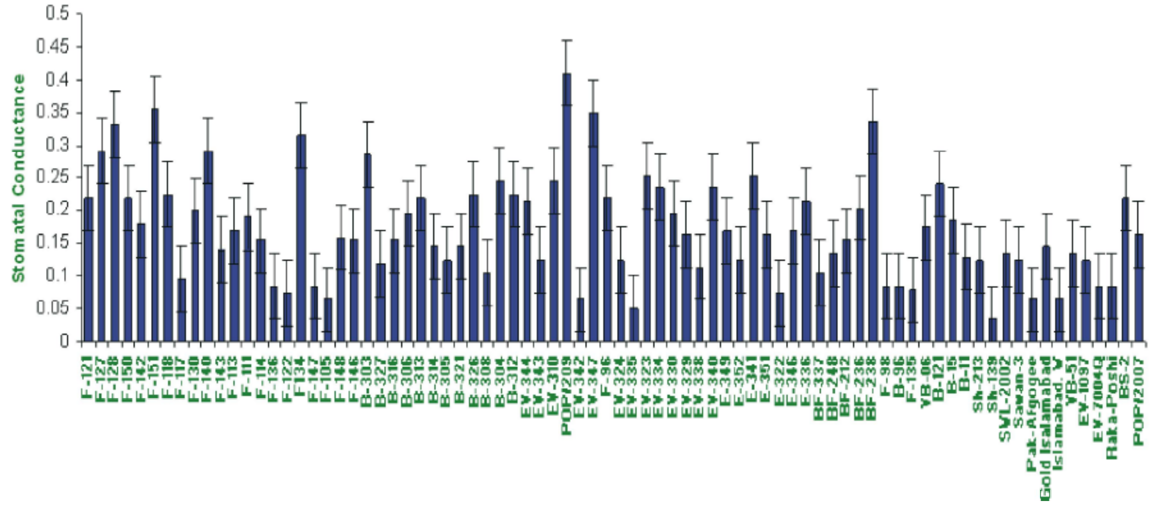

Fig. 4: Mean performance of maize accession for Stomata conductance (mmol m^{-2} s^{-1})

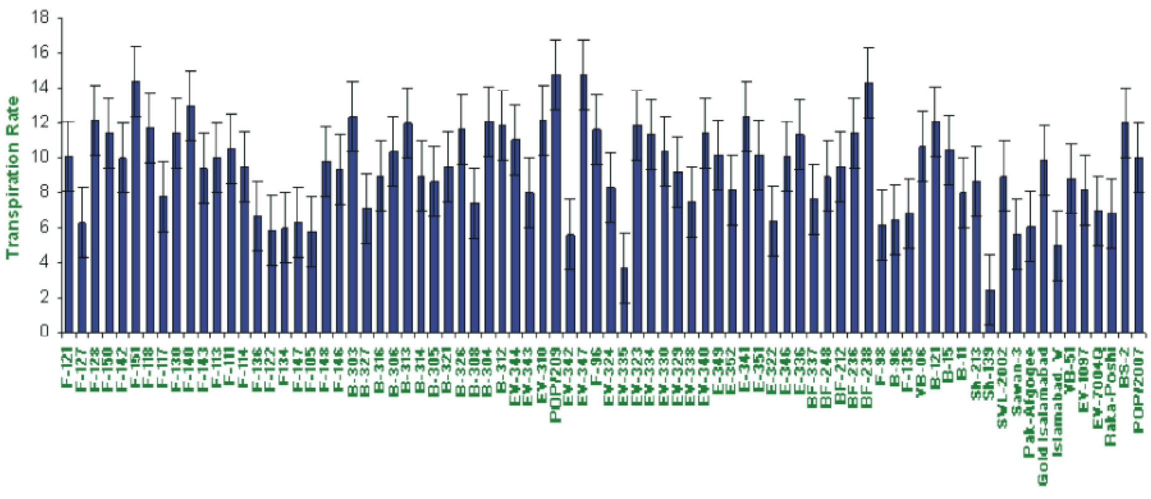

Fig. 5: Mean performance of maize accession for Transpiration rate (mm day^{-1})

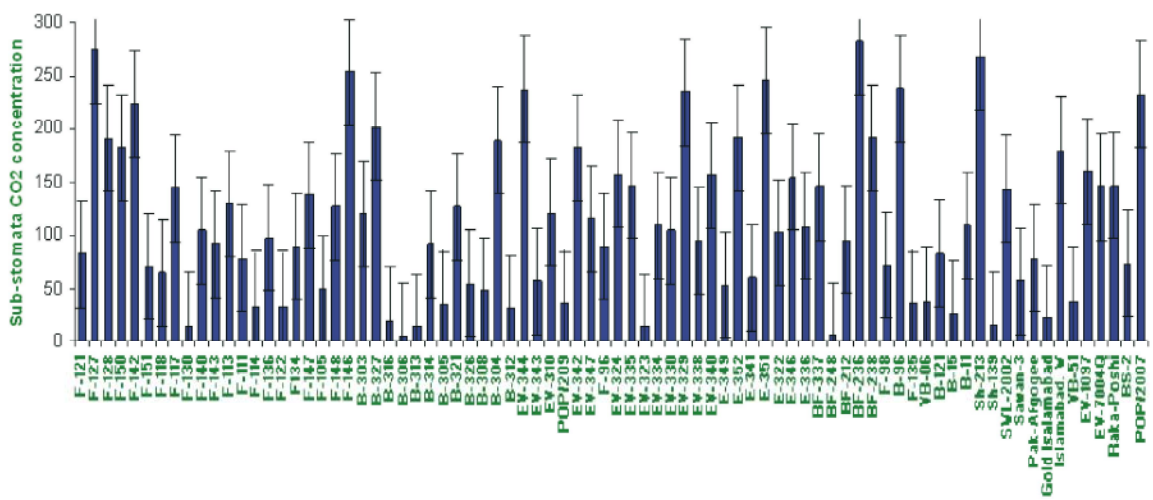

Fig. 6: Mean performance of maize accession for Sub-stomata CO_2 concentration (µmol mol^{-1} CO_2)

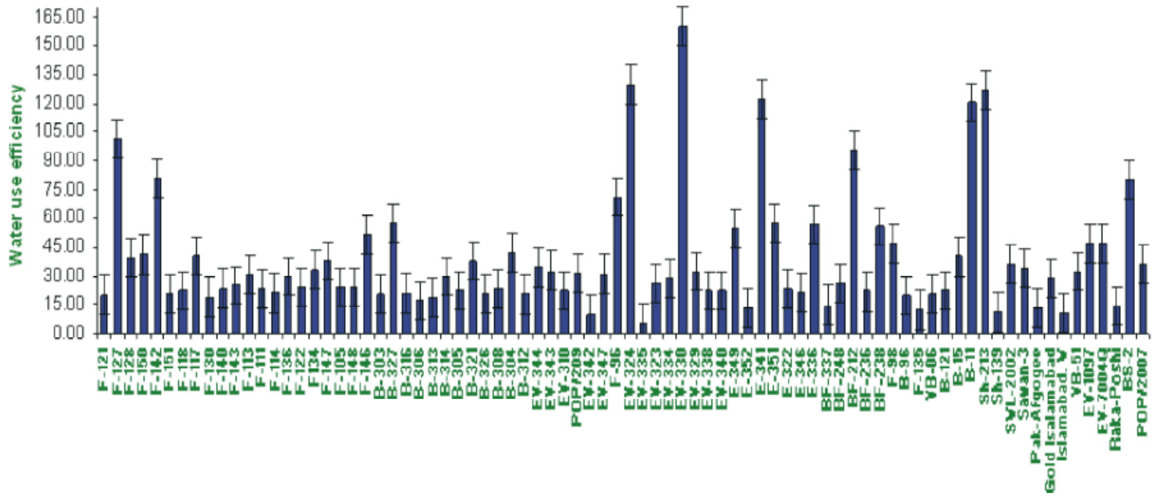

Fig. 7: Mean performance of maize accession for Water use efficiency (%)

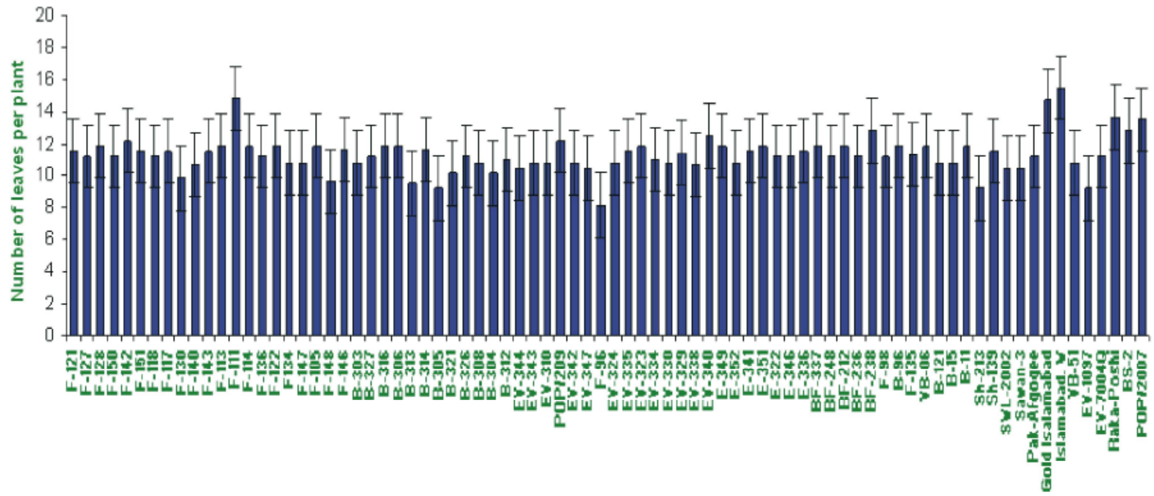

Fig. 8: Mean performance of maize accession for Leaves per plant

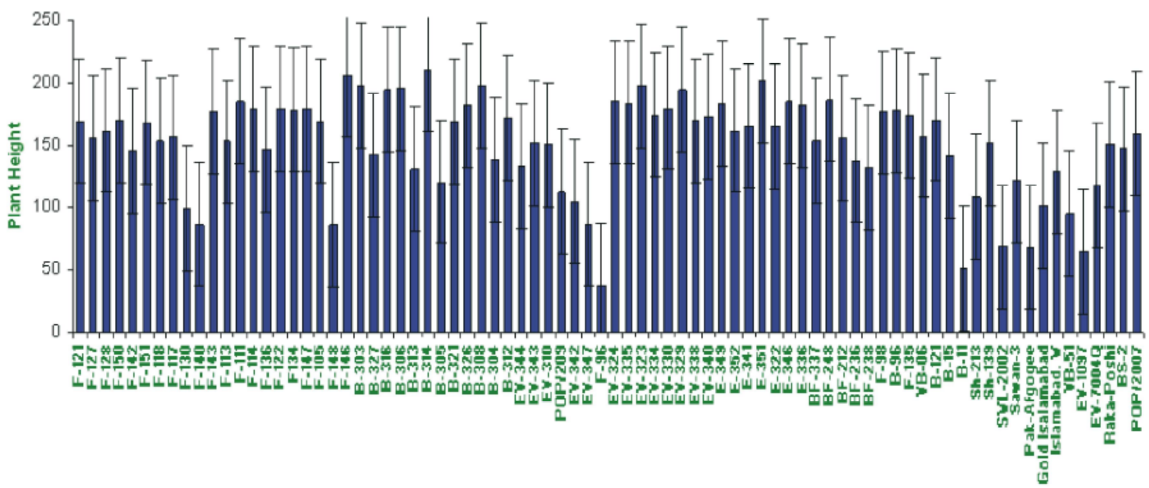

Fig. 9: Mean performance of maize accession for Plant height (cm)

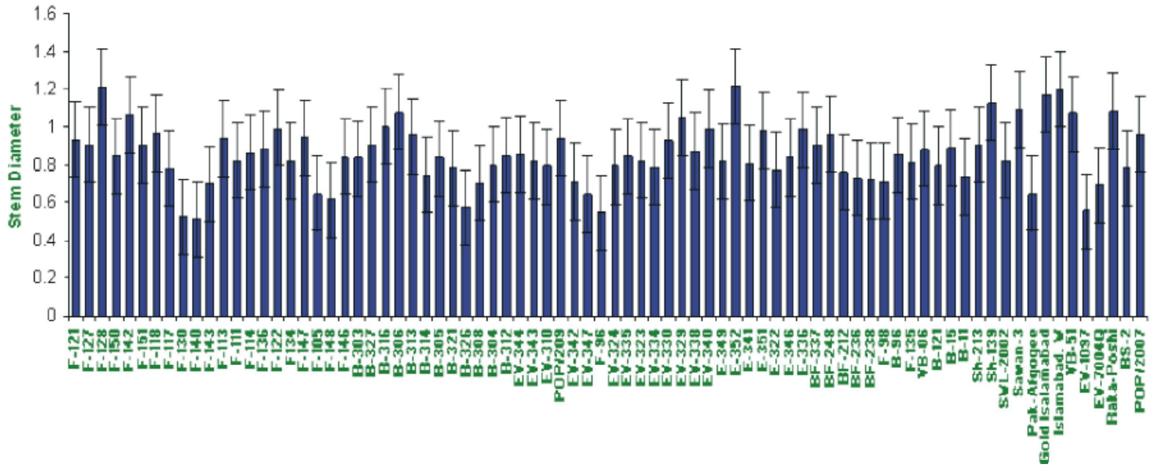

Fig. 10: Mean performance of maize accession for Stem diameter (cm)

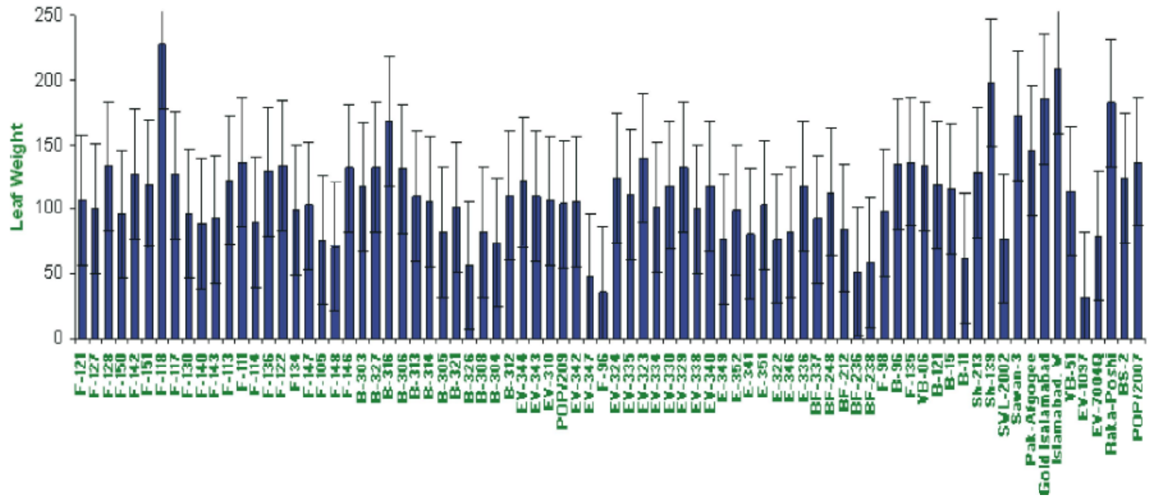

Fig. 11: Mean performance of maize accession for Leaf weight (g)

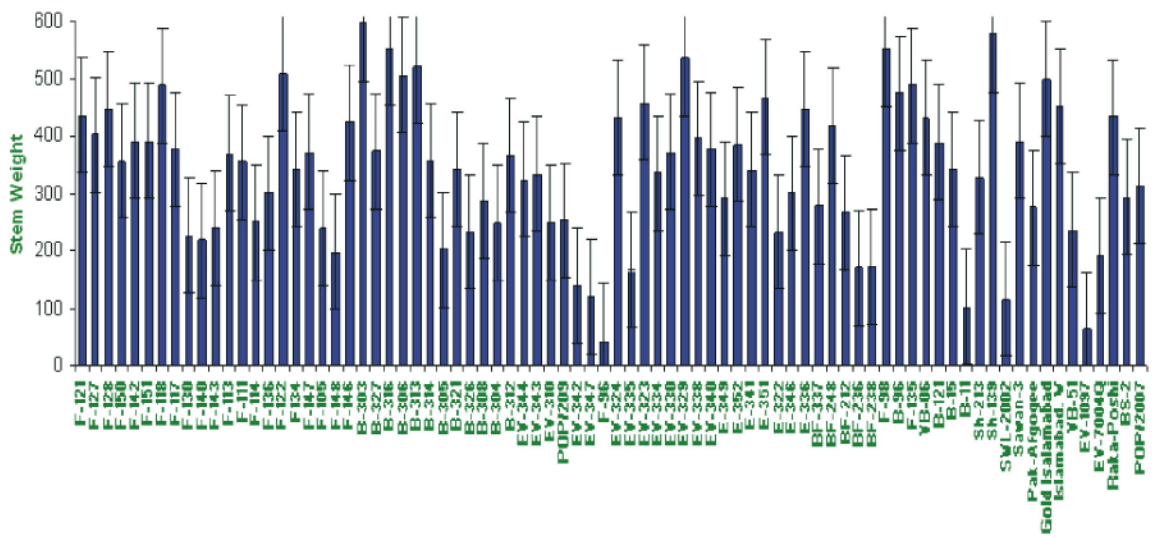

Fig. 12: Mean performance of maize accession for Stem weight (g)

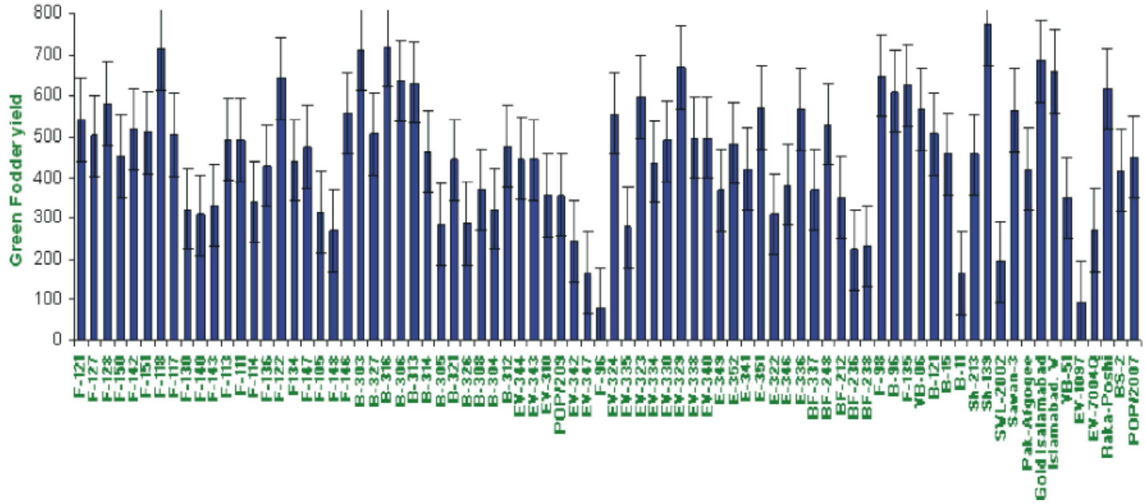

Fig. 13: Mean performance of maize accession for Green fodder yield (g)

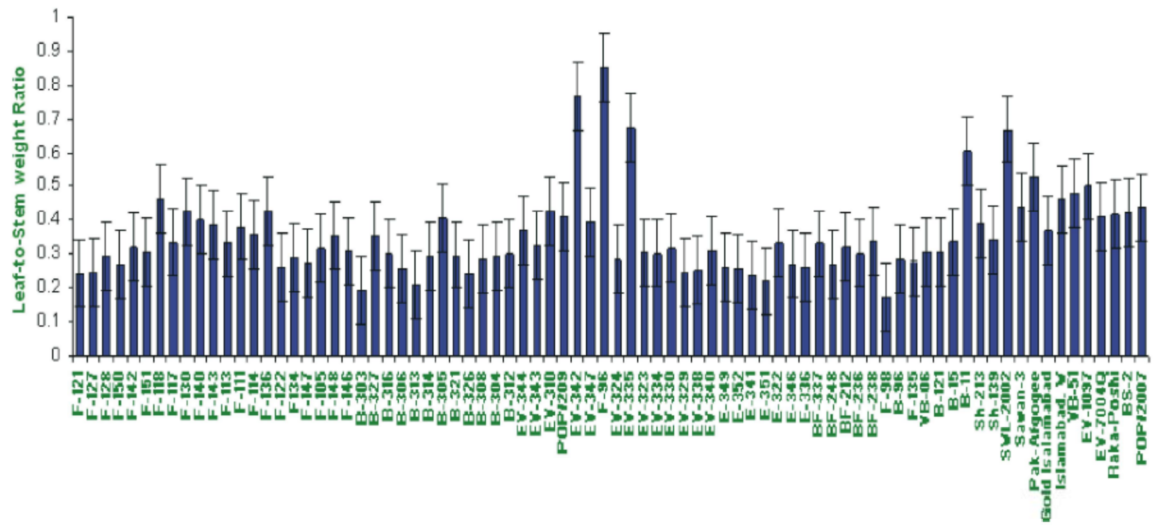

Fig. 14: Mean performance of maize accession for Leaf-stem weight ratio

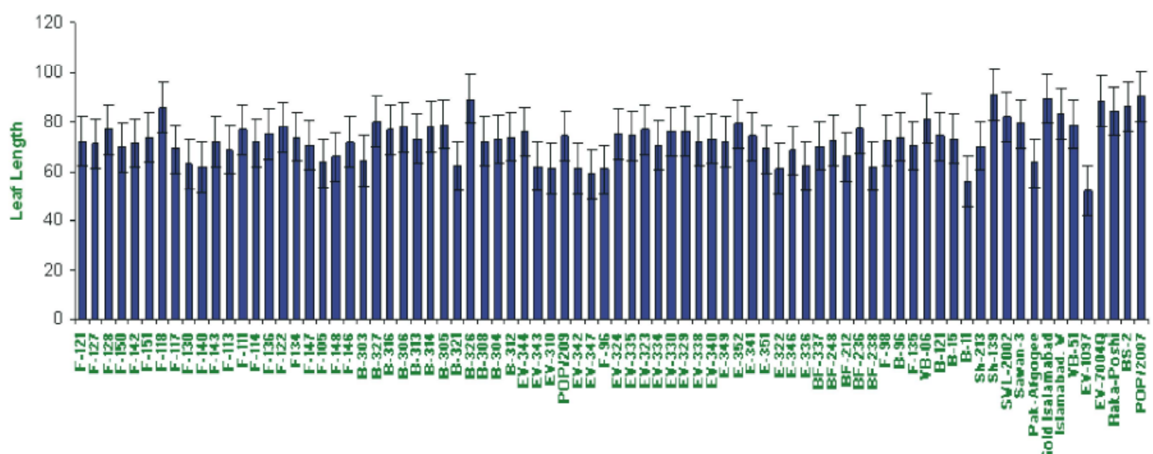

Fig. 15: Mean performance of maize accession for Leaf length (cm)

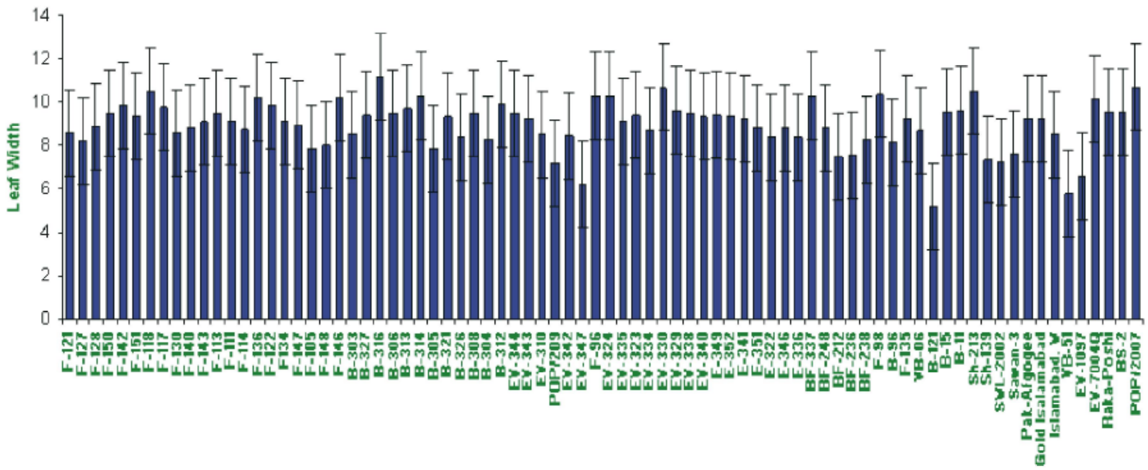

Fig. 16: Mean performance of maize accession for Leaf width (cm)

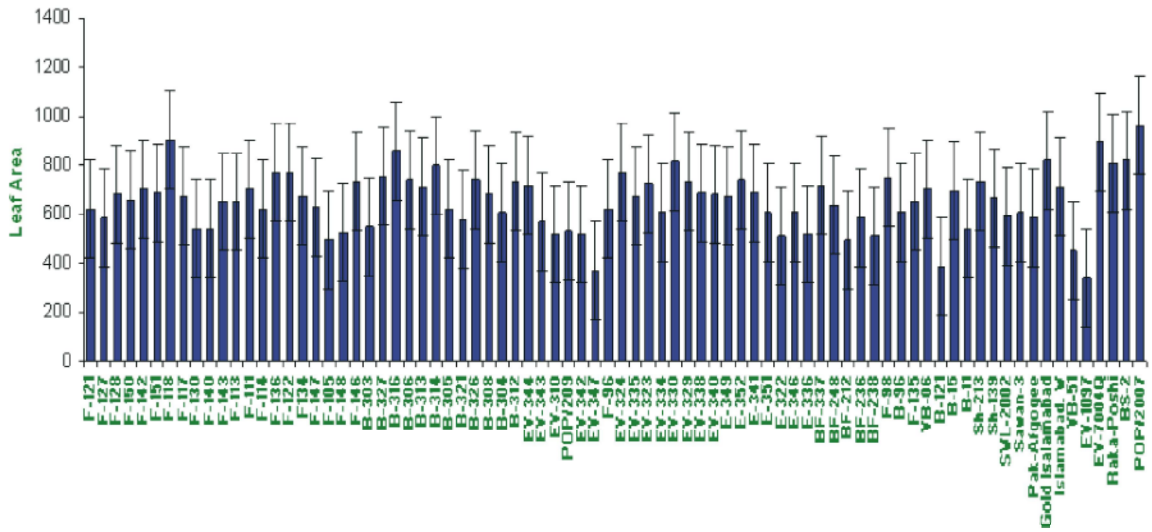

Fig. 17: Mean performance of maize accession for Leaf area (cm^2)

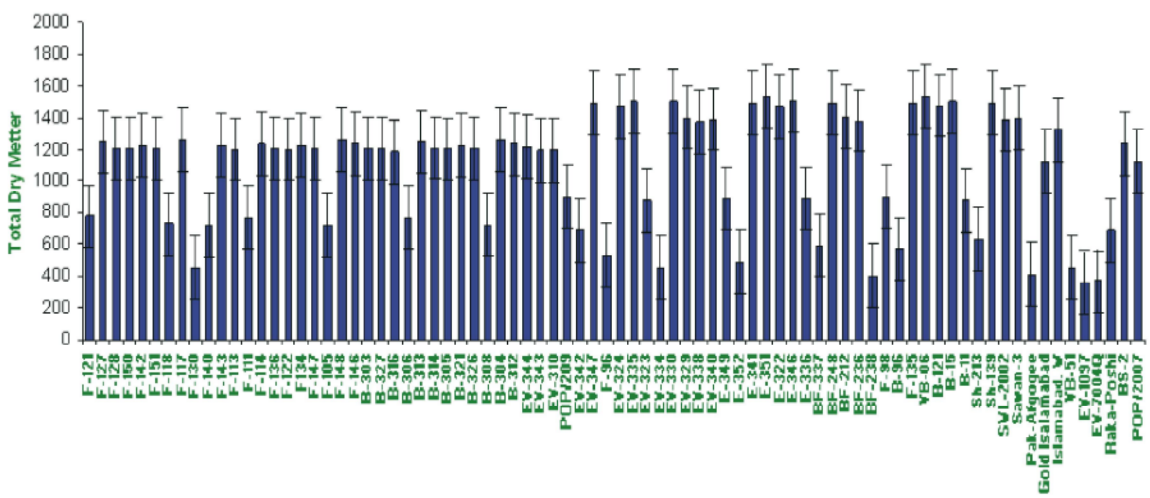

Fig. 18: Mean performance of maize accession for Total dry matter (g)

while E-351 the lowest value water use efficiency was F-142 followed by EV-335 [11-16]. It was suggested from the Fig. 8 that the highest leaves per plant was recorded for Islamabad W followed by F-111, while the lowest value of number of leaves per plant was B-305 followed by F-96. It was suggested from Fig. 3 the highest plant height was recorded for B-314 followed by F-146, while the lowest value of plant height was B-11 followed by F-96. It was suggested from the Fig. 10 that the highest stem diameter was recorded for E-352 followed by F-128, while the lowest value of stem diameter was F-96 followed by F-130 and F-140. It was suggested from the Fig.11 that the highest leaves weight was recorded for F-118 followed by Islamabad W, while the lowest value of leaf weight was F-96 followed by EV-1097 [14-16]. The higher leaves weight indicated accumulation of photosynthetic compounds was much higher. The higher leaves weight also persuaded that the chlorophyll contents were increased that caused the increase in growth and development of crop plants [14,15]. It was suggested from the Fig. 12 that the highest stem weight was recorded for B-303 followed by Sh-139 while the lowest value of stem weight was EV-1097 followed by F-96. The higher stem weight indicated accumulation of photosynthetic compounds was much higher. The higher stem weight also persuaded that the chlorophyll contents increased due to higher transport of water and minerals that caused the increase in growth and development of crop plants [17]. It was suggested from the Fig. 13 that the highest green fodder yield was recorded for Sh-139 followed by B-316, while the lowest value of green fodder yield was EV-1097 followed by F-96. The higher green fodder yield also persuaded that the chlorophyll contents were increased that caused the increase in growth and development of crop plants [17]. It was suggested from the Fig.14 that the highest leaf/stem weight ratio was recorded for Sh-139 followed by B-316 while the lowest value of leaf-stem ratio was EV-1097 followed by F-96. The higher leaf/stem weight ratio indicated accumulation of photosynthetic compounds was much higher [14-17]. It was suggested from the Fig. 15 that the highest leaf length were recorded for Sh-139 followed by Pop-2007, while the lowest value of leaf length was B-11 followed by Ev-1097. It was suggested from figure 16 that the highest leaf width were recorded for B-316 followed by EV-330 while the lowest value of leaf length was VB-51 followed by B-15. The higher leaf width also persuaded that the chlorophyll contents are increased that caused the increase in growth and development of crop plants [15-18]. It was suggested from Fig. 17 that the highest leaf area were recorded for Pop-2007 followed by F-118, while the lowest value of leaf area was EV-347 followed by EV-1097. The higher leaf area also persuaded that the chlorophyll contents are increased that caused the increase in growth and development of crop plants [17]. It was suggested from the Fig. 18 that the highest total dry matter were recorded for E-351 followed by VB-06, while the lowest value of total dry matter was EV-7004Q followed by EV-1097.

Correlation Analysis: It was suggested from Tables 1 and 2 that chlorophyll contents had a positive significant genotypic and phenotypic correlation with plant height, stem diameter, leaves weight, stem weight, green fodder yield, leaf/stem weight ratio, leaf length, leaf width, leaf area, photosynthetic rate and sub-stomata CO_2 concentration. A negative but significant genotypic and phenotypic correlation was found for water use efficiency. Significant correlation between chlorophyll contents with other traits indicated that the formation of organic compound and their accumulation is higher that may lead to improve the grain and fodder yield of maize [17]. It was shown from Tables 1 and 2 that leaves per plant showed a positive significant genotypic and phenotypic correlation with chlorophyll contents, plant height, stem diameter, leaf weight, stem weight, green fodder yield, leaf length, leaf area, water use efficiency and sub-stomata CO_2 concentration. Significant correlation between leaves per plant with other traits indicated that the formation of organic compound and their accumulation is higher that may lead to improve the grain and fodder yield of maize [17]. It was suggested from Tables 1 and 2 that plant height showed a positive significant genotypic and phenotypic correlation with leaves per plant, chlorophyll contents, stem diameter, leaves weight, stem weight, green fodder yield, leaf length, leaf width, leaf area and leaf temperature. A negative but significant genotypic and phenotypic correlation was found for leaf/stem weight ratio, stomata conductance, transpiration rate, sub-stomata CO_2 concentration and water use efficiency. Significant correlation between plant height with other traits indicated that the formation of organic compound and their accumulation is higher that may lead to improve the grain and fodder yield of maize [19-21]. It was persuaded from Tables 1 and 2 that stem diameter showed a positive significant genotypic and phenotypic correlation with plant height, leaves per plant, chlorophyll contents, leaf weight, stem weight, green fodder yield, leaf length, leaf width, leaf area, sub-stomata CO_2 concentration and photosynthetic rate. Significant correlation between stem diameter with other traits indicated that the formation of organic compound and their accumulation is higher that may lead to improve the grain and fodder yield of maize [21]. Significant correlation between leaves weight with other traits indicated that the formation of organic compound and their accumulation is higher that may lead to improve the grain and fodder yield of maize [15]. It was suggested from Tables 1 and 2 that positive significant genotypic and phenotypic correlation was found between stem weight and leaf weight, plant height, leaves per plant, chlorophyll contents, stem diameter, green fodder yield, leaf length, leaf width, leaf area, sub-stomata CO_2 concentration and leaf temperature. A negative but significant genotypic and phenotypic correlation was found for leaf/stem weight ratio. Significant correlation between stem weight with other traits indicated that the formation of organic compound and their accumulation is higher that may lead to improve the grain and fodder yield of maize [17]. It was suggested from Tables 1 and 2 that green fodder yield had a positive significant genotypic and phenotypic correlation with stem weight, leaf weight, plant height, leaves per plant, chlorophyll contents, stem diameter, leaf length, leaf width, leaf area, sub-stomata CO_2 concentration, photosynthetic rate and leaf temperature. A negative but significant genotypic and phenotypic correlation was found for leaf/stem weight ratio. Significant correlation between green fodder yield with other traits indicated that the formation of organic compound and their accumulation is higher that may lead to improve the grain and fodder yield of maize [16]. It was indicated from Tables 1 and 2 that positive leaf/stem weight ratio showed a significant genotypic and phenotypic correlation with chlorophyll contents, photosynthetic rate and leaf temperature. A negative but significant genotypic and phenotypic correlation was found for plant height, stem weight, green fodder yield, leaf width, leaf area and transpiration rate. Significant correlation between leaf/stem weight ratio with other traits indicated that the formation of organic compound and their accumulation is higher that may lead to improve the grain and fodder yield of maize [22]. It was suggested from Tables 1 and 2 that leaf length showed a positive significant genotypic and phenotypic correlation with leaves per plant, plant height, stem diameter, leaf weight, stem weight, green fodder yield, leaf width, leaf area, chlorophyll contents, sub-stomata CO_2 concentration, photosynthetic rate and leaf temperature. Significant correlation between green fodder yield with other traits indicated that the formation of organic compound and their accumulation is higher that may lead to improve the grain and fodder yield of maize [11-13]. It was revealed from Tables 1 and 2 that leaf width showed a positive significant genotypic and phenotypic correlation with leaf length, plant height, stem diameter, leaves weight, stem weight, green fodder yield, leaf area and chlorophyll contents. A negative but significant genotypic and phenotypic correlation was found for leaf/stem weight ratio, transpiration rate and stomata conductance. Significant correlation between leaf length with other traits indicated that the formation of organic compound and their accumulation is higher that may lead to improve the grain and fodder yield of maize [21]. It was found from Tables 1 and 2 that leaf area showed a positive significant genotypic and phenotypic correlation with leaf width, leaf length, plant height, stem diameter, leaves weight, stem weight, green fodder yield, chlorophyll contents, leaf temperature and photosynthetic rate. A negative but significant genotypic and phenotypic correlation was found for leaf/stem weight ratio, transpiration rate and stomata conductance. Significant correlation between leaf width with other traits indicated that the formation of organic compound and their accumulation is higher that may lead to improve the grain and fodder yield of maize [19-21]. It was persuaded from Tables 1 and 2 that leaf temperature had a positive significant genotypic and phenotypic correlation with leaf area, leaf width, leaf length, leaf/stem weight ratio, plant height, sub-stomata CO_2 concentration, stem diameter, leaves weight, stem weight and green fodder yield. A negative but significant genotypic and phenotypic correlation was found for photosynthetic rate, transpiration rate and water use efficiency. Significant correlation between leaf temperature with other traits indicated that the formation of organic compound and their accumulation is higher that may lead to improve the grain and fodder yield of maize [23]. It was suggested from Tables 1 and 2 that positive significant genotypic and phenotypic correlation was found between photosynthetic rate and leaf area, leaf length, leaf/stem weight ratio, transpiration rate, sub-stomata CO_2 concentration, stem diameter, leaves weight and green fodder yield. A negative but significant genotypic and phenotypic correlation was found for water use efficiency. Significant correlation between photosynthetic rate with other traits indicated that the formation of organic compound and their accumulation is higher that may

Table 1: Genotypic correlations among various morphological and physiological traits in maize

Traits	NLP	PH	SD	LW	SW	GFY	LSWR	LL	LW	LA	LT	A	gs	E	Ci	WE
Ch.C	0.0105ns	0.3515*	0.2899*	0.3729*	0.1782*	0.2204*	0.1801*	0.2464*	0.1457*	0.2395*	0.0280 ns	0.1499*	-0.0428 ns	-0.0825 ns	0.0213*	-0.1834*
NLP		0.5525*	0.2791*	0.3135*	0.1546*	0.1854*	0.0665 ns	0.1668*	-0.0233 ns	0.0937**	0.1631 ns	-0.0446 ns	0.0374 ns	-0.0164 ns	0.1337*	0.1152*
PH			0.3991*	0.5437*	0.5761*	05945*	-0.2367*	0.3551*	0.3857*	0.4710*	0.3481*	-0.0069 ns	-0.2920*	-0.0629 ns	0.0244*	-0.1654*
SD				0.6120*	0.5552*	0.5858*	-0.1188 ns	0.3285*	0.2769**	0.3800*	0.0372 ns	0.1531*	-0.0468 ns	-0.2841*	0.1512*	-0.0462 ns
LW					0.7300*	0.8132*	0.0693 ns	0.3139*	0.4716*	0.5087*	0.2427*	0.1142*	-0.2116*	-0.2555*	0.1190*	-0.1077 ns
SW						0.9927*	-0.5581*	0.2867*	0.5410*	0.5310*	0.1045*	-0.0052 ns	-0.0974 ns	-0.0724 ns	0.0251**	-0.0501 ns
GFY							-0.4610*	0.3037*	0.5503*	0.5489*	0.1435*	0.0134*	-0.1280 ns	-0.1151 ns	0.0416**	-0.0611 ns
LSWR								-0.1615 ns	-0.2742*	-0.2661*	0.2099*	0.2696*	-0.1610 ns	-0.2713*	0.1154*	-0.1426 ns
LL									0.2999*	0.7658*	0.0859*	0.1207*	-0.0646 ns	-0.0560 ns	0.0255*	-0.0262 ns
LW										0.8409*	0.2289*	-0.069*	-0.3132*	-0.2769*	-0.0326 ns	-0.0692 ns
LA											0.2064*	0.0256*	-0.2412*	-0.2137*	-0.0066 ns	-0.0647 ns
LT												-0.1240	-0.9624*	-0.9865*	0.0642*	-0.3014*
A													0.0360 ns	0.0489*	0.0185**	-0.7508*
gs														0.9690*	-0.0455 ns	0.4127*
E															-0.0359 ns	0.3578*
Ci																-0.1136 ns

Table 2: Phenotypic correlations among various morphological and physiological traits in maize

Traits	NLP	PH	SD	LW	SW	GFY	LSWR	LL	LW	LA	LT	A	gs	E	Ci	WE
Ch.C	0.0097 ns	0.3480*	0.2878*	0.3706*	0.1774**	0.2190*	0.1785**	0.2452*	0.1448*	0.2383*	0.0248 ns	0.1486*	-0.0427 ns	-0.0818 ns	0.0210*	-0.1821*
NLP		0.5342*	0.2735*	0.3050*	0.1515**	0.1811**	0.0643 ns	0.1613**	-0.0182	0.0938**	0.1446 ns	-0.0429 ns	0.0364 ns	-0.0163 ns	0.1288*	0.1110*
PH			0.3965*	0.5406*	0.5738*	0.5923*	0.2355*	0.3538*	0.3838*	0.4688*	0.3364*	-0.0068	-0.2982*	-0.2830**	0.0242**	-0.1646*
SD				0.6086*	0.5527*	0.5830*	-0.1182 ns	0.3260*	0.2752*	0.3779*	0.0356 ns	0.1521**	-0.0463 ns	-0.0627	0.1501**	-0.0461 ns
LW					0.7271*	0.8103*	0.0734 ns	0.3128*	0.4696*	0.5076*	0.2323*	0.1140**	-0.2105*	-0.2543**	0.1184*	-0.1075 ns
SW						0.9908*	-0.5567*	0.2856*	0.5392*	0.5297*	0.1002**	-0.0052 ns	-0.0969 ns	-0.0723 ns	0.0250**	-0.0504 ns
GFY							-0.4591 ns	0.3028*	0.5485*	0.5476*	0.1365*	0.0131**	-0.1279 ns	-0.1150 ns	0.0417**	-0.0611 ns
LSWR								-0.1607 ns	-0.2729*	-0.2651*	0.2019*	0.2687*	-0.1600 ns	0.2704**	0.1150*	-0.1423 ns
LL									0.2987*	0.7645*	0.0859**	0.1207**	-0.0648 ns	-0.0557 ns	0.0253**	-0.0265 ns
LW										0.8406*	0.2179*	-0.0685	-0.3126*	-0.2757**	-0.0326 ns	-0.0692 ns
LA											0.1965*	0.0259**	-0.2409**	-0.2132 ns	-0.0068 ns	-0.0649 ns
LT												-0.1198 ns	-0.9184*	-0.9451**	0.0609**	-0.2892**
A													0.0360 ns	0.0491**	0.0183**	-0.7501**
Gs														0.9659*	-0.0455 ns	0.4114**
E															-0.0360 ns	0.3574**
Ci																-0.1136 ns

** = Significant at 5% significance level, * = Significance at 1% significance level, ns = Non-significant, NLP = leaves per plant, PH = Plant height, SD = Stem diameter, LW = Leaf weight, SW = Stem weight, GFY = Green fodder yield, LSWR = Leaf to stem weight ratio, LL = Leaf length, LW = Leaf width, LA = Leaf area, A = Photosynthetic rate, LT = Leaf temperature, Chl. C = Chlorophyll contents, gs = Stomata conductance, E = Transpiration rate, Ci = Sub-stomata CO_2 concentration

lead to improve the grain and fodder yield of maize [23]. It was indicated from Tables 1 and 2 that stomata conductance showed a positive significant genotypic and phenotypic correlation with transpiration rate and water use efficiency. A negative but significant genotypic and phenotypic correlation was found for leaf area, leaf width, leaf temperature, leaves weight and plant height. Significant correlation between stomata conductance with other traits indicated that the selection may be effective to improve the grain and fodder yield of maize under drought conditions [23,24]. It was found from Tables 1 and 2 that transpiration rate showed a positive significant genotypic and phenotypic correlation with photosynthetic rate, water use efficiency and stomata conductance. A negative but significant genotypic and phenotypic correlation was found for and leaf area, leaf width, leaf/stem weight ratio, leaf weight and plant height. Significant correlation between transpiration rate with other traits indicated that the selection may be effective to improve the grain and fodder yield of maize under drought conditions [21-29]. It was indicated from Tables 1 and 2 that sub-stomata CO_2 concentration showed a positive significant genotypic and phenotypic correlation with photosynthetic rate, leaf temperature, leaf length, water use efficiency leaf/stem weight ratio, leaf weight, green fodder yield, stem diameter, leaves per plant, chlorophyll contents, stem weight and plant height. Significant correlation between sub-stomata CO_2 concentration with other traits indicated that the selection may be effective to improve the grain and fodder yield of maize under drought conditions [29-35]. It was suggested from Tables 1 and 2 that water use efficiency had a positive significant genotypic and phenotypic correlation with leaves per plant, transpiration rate and stomata conductance. A negative but significant genotypic and phenotypic correlation was found for chlorophyll contents, photosynthetic rate, leaf temperature and plant height. Significant Correlation between water use efficiency with other traits indicated that the selection may be effective to improve the yield potential of genotypes under normal and drought conditions [36-39].

CONCLUSIONS

It was concluded that significant genotypic and phenotypic correlations were found high among chlorophyll contents, leaves per plant, plant height, leaves weight, stem weight, green fodder yield, leaf area and transpiration rate. It was suggested that selection of higher fodder yielding genotypes may be helpful to enhance crop yield and productivity.

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