

USE OF GGE-BIPLLOT ANALYSIS TO COMPARISON PERFORMANCES AMONG CURRENT COMMERCIAL CULTIVARS AND NEW PROMISING LINES OF COTTON UNDER NEW RECLAMATION REGION

EI-Akhedar, A. A. ; A. M. R. Abd El-Bary ; H. M. Hamoud and M. A. Abou El-Yazied

Cotton Research Institute, Agricultural Research Center, Giza, Egypt

ABSTRACT

This study was conducted during 2009 and 2010 seasons to evaluate the performance of commercial varieties and new promising lines of cotton in new area under new system of irrigation (drip irrigation). A graphic summary of the data using GGE Biplot was used to characterize the performances of genotypes. Long stable genotypes were surpassed in yield properties meanwhile extra long stable were better in fiber quality except for G84 x Ps6 which was strong competitiveness for long stable genotypes in lint percentage. The results showed that the new promising line 10229xG86 was the better under these conditions for seed cotton yield and lint cotton yield, G86 was better for lint percentage and G77xPs6 was better for fiber length meanwhile each of G88 and G84xPs6 were better for year strength. Genotypes were always the most important source of variation which ranged from 65.03 for seed cotton yield to 92.5 for year strength.

INTRODUCTION

With respect to dedicate a large amount of area to cereal crops in Delta region, it is urgent to evaluate the cotton cultivation in new reclamation area as a trend to expansion in cotton area in these locations. A cultivar or genotype is considered to be more adaptive or stable if it has a high mean yield but a low degree of fluctuation in yielding ability when grown in diverse environment (Arshad *et al.*, 2003). Typically, E explains 80% or higher of the total yield variation, however it is G and GE that are relevant to cultivar evaluation (Yan, 2002). The predictive power of a single- year trial may be better appreciated when cultivar are divided into superior and inferior (Yan and Rajcan 2002). In analyzing Ontario winter wheat performance trial data, (Yan, 1999 and Yan *et al.*, 2000) proposed a GGE Biplot, constructed from the first two principle components (Pc1 and Pc2) derived from Pc analysis of environments centered yield data. Although the GGE biplot methodology was developed for MET data analysis, it should be applicable to all types of two-way data that assume and entry – by tester data structure, (Yan and Hunt, 2002)

Agronomic data typically contain complex interactions that are difficult to understand without the aid of some graphical display. Ma *et al.*, (2004) demonstrated that biplots are useful tools for understanding complex agronomic.

The main objective of this study is to evaluate performances of current commercial cultivars and future promising lines in new reclamation area and under system of irrigation (drip irrigation). Furthermore, providing a detail description about a relationship between these genotypes.

MATERIALS AND METHODS

Commercial available cotton cultivar and new promising line were planted at two seasons in Elnobaria farm, Elbehera governorate 2009 and 2010. Seven genotypes evaluated under drip irrigation system, Randomized complete design was used and four row plots were replicated three time. Rows were 20 m long and spaced 80 cm apart. Genotypes included in study (Table 1) belong to two main categories which were extra long stable and long stable categories. The genotypes chosen for this study comprised the wide range of current and future cultivars which represented a wide variability.

Yield component measured included seed cotton yield, lint cotton yield and lint percentage. Fiber properties analyzed were fiber length and yearn strength. The proc mixed model (release 8.0; SAS Institute; Cary NC, 2000) was used to create an analysis of variance (ANOVA). Table 2 determines the presence or absence of GY interaction. The presence of total variation attributes to Y, G or GY interactions were calculated using the sums of squares from ANOVA table, response variables that had significant G or GY interactions were analyzed in GGE biplot, mean performances stability of genotypes were characterized. Graphical GGE biplot is designed to examine G main effect and GE interactions (Yan *et al.*, 2000; Yan, 2001)

GGE biplot methodology was developed originally for analysis data (Yan, 1999, Yan *et al.*, 2000) and genotype x trait data (Yan and Rajcan, 2002)

RESULTS AND DISCUSSION

Analysis of variance. The percentage of the total sums of squares accounted by G, Y and GY interactions were used as indicator of total variation attributed to each component for the data was presented in Table 2 which gave an overall picture of the relative magnitude of G, Y and GY interactions variance terms. Variations due to G or GY interactions are a measure of how cultivars respond across years. In this study, genotypes were always the most important source of variation and this mainly come back to use divergent genotype which belong for different categories. Studied have shown that genotype typically accounts for > 53 % of total variation in fiber length and the total variation for Years ranged from 0.12 for lint cotton yield to 2.82 for yearn strength, while for Genotypes ranged from 65.03 for seed cotton yield to 92.5 for yearn strength and for Genotypes x Years interactions ranged from 3.24 for yearn strength to 23.5 for lint percentage.

Table 1. Abbreviation, full name, Category, usage and origin

Abbreviation	Full name	Category	Usage	origin
G86	Giza 86	Long stable variety	Commercial variety	Egypt
G88	Giza 88	Extra long stable variety	Commercial variety	Egypt
G92	Giza 92	Extra long stable variety	Commercial variety	Egypt
10229xG86	10229 x Giza 86	Long stable variety	New promising line	Egypt
G89xG86	Giza 89 x Giza 86	Long stable variety	New promising line	Egypt
G77xPs6	Giza 77 x Pima s6	Extra long stable variety	New promising line	Egypt
G84xP62	G84x(Giza70xGiza 51B)x Pima 62	Extra long stable variety	New promising line	Egypt

Table2. Degrees of freedom, sum of squares, significant level, and percentages of total variation genotypes of genotypes (G) and Years (Y) and genotype by Years (GY) interaction)

Trait	source	df	ANOVA			Total variation (%)
			SS	MS	Pr>F	
Seed Cotton Yield	Y	1	375165.006	375165	1.089365	0.957362
	G	6	25484056.2	4247343	12.33299	65.03132
	GY	6	3607618.37	601269.7	1.745905	9.206077
Lint Cotton Yield	Y	1	7790.09524	7790.095	0.143347	0.120755
	G	6	4258135.9	709689.3	13.05915	66.00593
	GY	6	654002.571	109000.4	2.005741	10.13778
Lent percentage	Y	1	2.02477866	2.024779	7.049035	1.444079
	G	6	96.9502684	16.15838	56.25355	69.14528
	GY	6	32.9656367	5.494273	19.12768	23.51121
Fiber length	Y	1	0.38095238	0.380952	0.111861	0.144443
	G	6	141.722381	23.6204	6.935762	53.73584
	GY	6	26.6290476	4.438175	1.303201	10.09674
Yearm Strength	Y	1	101332.595	101332.6	55.96878	2.821605
	G	6	3322139.62	553689.9	305.8182	92.50495
	GY	6	116535.905	19422.65	10.72767	3.244941

Seed cotton yield:

A. Relationship among genotypes;

Figure 1 showed the relation among genotypes under investigation which the cosine of angle between vectors of two genotypes approximately refer to the correlation coefficient between them. When the biplot explains only a large portion of the total variation, more than 50% (69% in this case) the angle exactly related to the correlation between the entries. Two genotypes are positively correlated if the angle between the vector < 90, degree; they are negative correlated if the angle between their vectors > 90 degree. Two entries are independent between them is 90 degree. Zero means, correlation $r = 1$, 180 degree means $r = -1$.

The acute angle is found between 10229xG86 and G86 are closely correlated but G89xG68 was more discriminating. The same direction was found between each of G92 and G84xP62, G88 and G77xPs6 as prairies. Meanwhile G89xG86 was independent with each of G92 and G84xP62. The liner map in the same figure showed the same relation.

B. Average Tester Coordination (ATC), which measure ranking based on mean and stability in figure 2. Genotypic PC1 scores > 0 detected the adaptable and/or higher-yielding genotypes. While PC1 scores < 0 discriminated the non-adaptable and/or lower-yielding ones. Unlike genotypic PC1 scores near-zero PC2 scores identified stable genotypes, whereas absolute larger PC2 scores detected the unstable ones (Kaya *et al.*, 2006) which showed that each of G89xG86, G86 and 10229xG86 were above grand mean. Meanwhile the other genotypes were under grand mean. With respect to stability the results showed that as well as decrease the distance between any genotypes with the ATC the stability increase. So, 10229xG86, G86 and G88 were more stable in comparison with other genotypes, while G89xG86 was more instability.

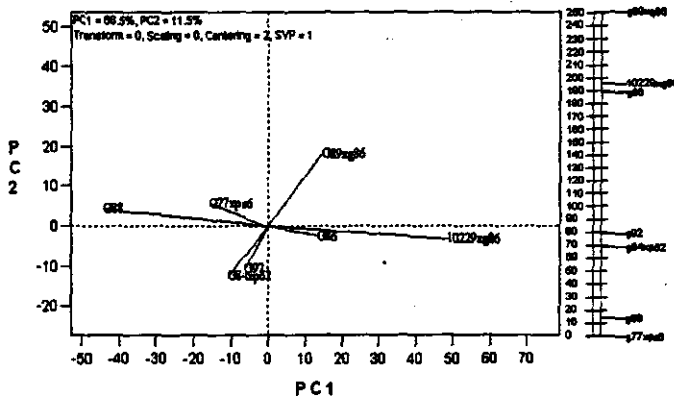


Figure 1: Relationship among entries for Seed cotton Yield

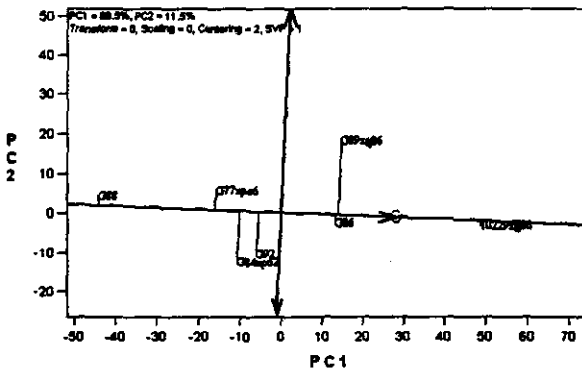


Figure 2: Average tester coordination (ATC) view of the GGE-biplot for Seed Cotton Yield

Lint cotton yield

Either for relationship among genotypes figure 3 and both means and stability figure 4 the results showed the genotypes behaved and observed approximately the same direction and performances such as seed cotton yield.

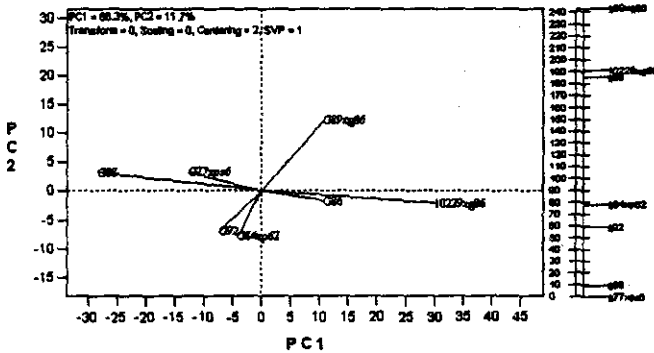


Figure 3: Relationship among entries for Lint cotton Yield

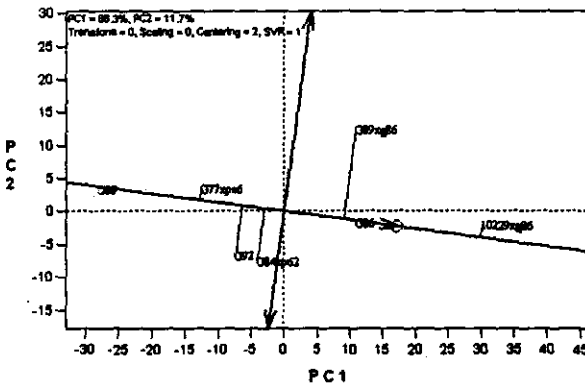


Figure 4: Average Tester Coordination (A.T.C.) view of the GGE-biplot for Years 9 & 10

Lint percentage;

A. Relationship among genotypes figure 5 showed that positive correlation observed between each of 10229xG86, G86 and G84xP62 and also between each of G77xPs6 and G92 which acute angle was noticed among them in contrast independent correlation revealed between the previous two groups. Also, independent correlation was observed between G89xG86 and G88.

B. Average Tester Coordination (ATC), figure 6 showed that the group G86, G84xP62 and 10229xG86 were above grand mean and higher yielding meanwhile 10229xG86 was more variable. In the other direction, the other genotypes was under grand mean which G88 was very closet to grand mean but in the same time each of G88 and G89xG86 were more variable in comparison with other genotypes.

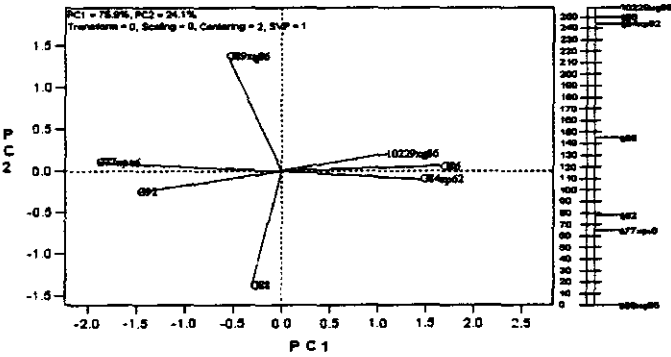


Figure 5: Relationship among entries for Lint Percentage

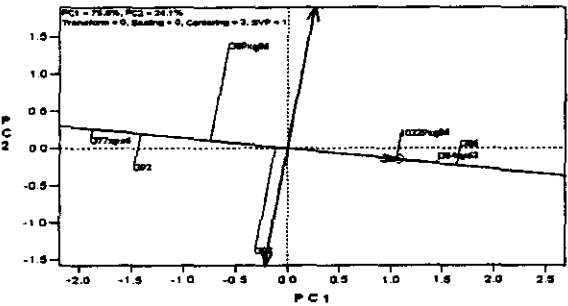


Figure 6: Average Tester Coordination (ATC) view of the GGE-biplot for Lint Percentage

Fiber length;

- A. Relationship among genotypes, figure 7 revealed that extra long stable genotypes were represent one group (closely correlated) as it clearly obvious from the figure and liner map except G92 which showed relatively independent (90 degree) from all genotypes. Meanwhile each of 10229xG86 and G89xG86 were very close seems to be corresponding and also they have acute angle (positive correlation) with G86, but it was more discriminating. But all long stable genotypes have negative correlation with G77xPs6, G88 and G84xP62.
- B. For Average Tester Coordination (ATC), figure 8 showed ranking which G77xPs6 > G84xP62 > G88 and all of them above the grand mean. In the other direction the results showed that G92 > 10229xG86 > G89xG86 > G86 but they all lower than the grand mean and G86 was more variable than others.

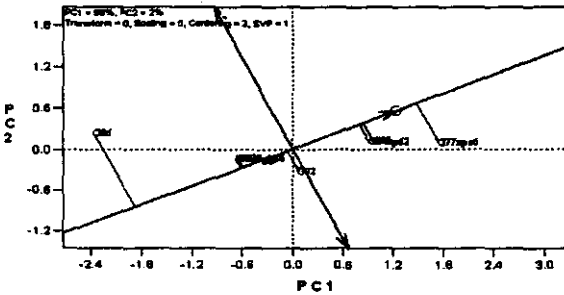


Figure 6: Average Tester Coordination (ATC) view of the OGE bipart for Fiber Length

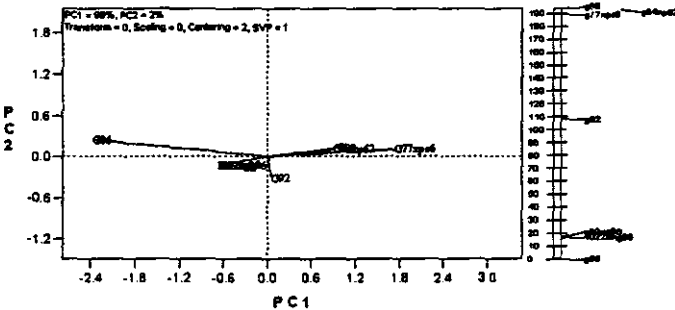


Figure 7: Relationship among entries for Fiber Length

Yarn strength;

- A. Figure 9 observed the relationship among groups which revealed more discrimination between extra long stable and long stable genotypes with positive correlation inside each group and negative correlation between each other and this were more obvious from liner map which each group located in different side.
- B. Average tester coordination (ATC) figure 10 revealed that performances for extra long stable were above grand mean and G84xP62 was more variable, but G88 and G92 were more stable. In the other direction, long stable were lower than grand mean and ranking was G89xG86 > 10229xG86 > G86.

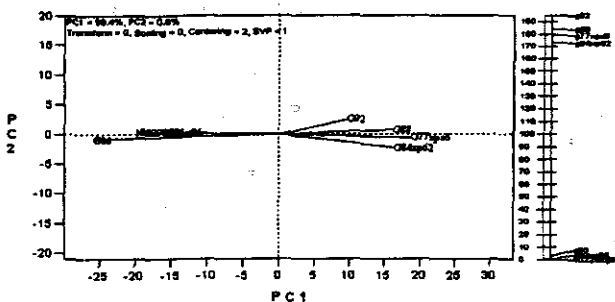


Figure 9: Relationship among entries for Year Strength

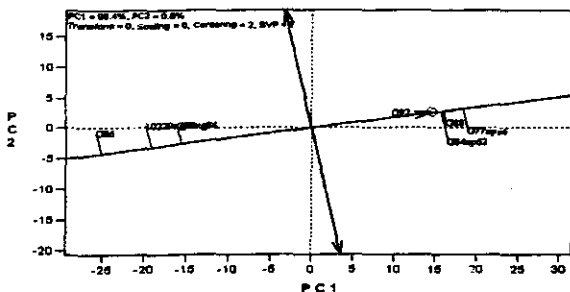


Figure 10: Average Tester Coordination (ATC) view of the GGE-biplot for Year strength

Which won where, which is the best for what?

The GGE biplot account for 75.2 % and 17% for each PC1 and PC2 respectively for the total variation of the standardized data while (Hamoud, 2008) reported that total variation for PC1 and PC2 were 38.8 % and 30.2 %, respectively. From the figure 11 revealed which genotype is the best for which trait. The polygon view of a biplot is the best way to visualize the interaction pattern among entries and to effectively interpret a biplot (Yan and Kang, 2003). The rays in figure divided the polygon into five sectors and the vertex genotypes for each sector have higher performances for each trait located in the sector. The results showed that the promising line 10229xG86 was the best for each of seed cotton yield and lint cotton yield. But G77xPs6 was the best for fiber length; meanwhile, the three genotypes G77xPs6, G88 and G84xP62 were the best for year strength. On the other hand, G86 was the best for lint percentage.

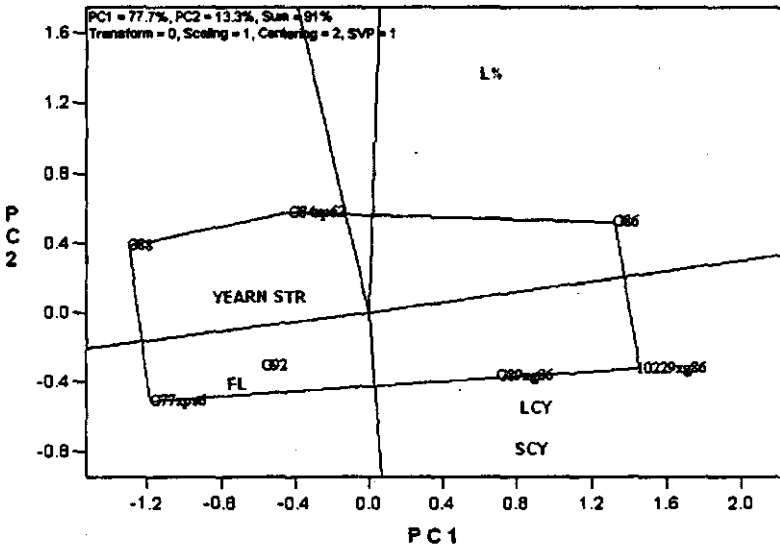


Figure 11: Polygon view of the GGE-biplot for the which is the best for what

REFERENCES

- Arshad, M., A. Bakhsh, A.M. Haggani, and M. Bashir. 2003. Genotype-environment interaction for grain yield in chickpea (*Cicer arietinum*). *Pakistan J. Bot.* 35:181-186, 318.
- Hamoud, H.M.E 2008. Studies on Genotype x Environment Interaction using GGE-Biplot Analysis for seed Cotton Yield in Delta region of Egypt. *Egypt J. Agric. Res.*, 86 (6). 2351-2364
- Kaya, Y., y Akcura and S. Taner. 2006. GGE-biplot analysis of multi-environment yield trials in bread wheat. *Turk J. Agric.* 30: 325-337.
- Ma, B. L., W. Yan, L. M. Dwyer, J. Frégeau-Reid, H. D. Voldeng, Y. Dion and H. Nass. 2004. Graphic Analysis of Genotype, Environment, Nitrogen Fertilizer, and Their Interactions on Spring Wheat Yield. *Agron. J.* 96:169-180.
- SAS Institute. 2000. SAS/STAT user's guide, version 8. SAS Inst., Cary, NC.
- Yan, W. 1999. A Study on the Methodology of Yield Trial Data Analysis—with Special Reference to Winter Wheat in Ontario. PhD. diss., University of Guelph, Guelph, Ontario, Canada.
- Yan, W. 2001. GGEBiplot—A Windows application for graphical analysis of multi-environmental trial data and other types of two-way data. *Agron. J.* 93:1111-1118.
- Yan, W. 2002. Singular-value partition for biplot analysis of multi-environment trial data. *Agron. J.* 94:990-996.

- Yan, W., and I. Rajcan. 2002. Biplot evaluation of test sites and trait relations of soybean in Ontario. *Crop Sci.* 42:11-20.
- Yan, W., and L.A. Hunt. 2002. Biplot analysis of diallel data. *Crop Sci.* 42:21-30.
- Yan, W., and M.S. Kang. 2003. GGE biplot analysis: A graphical tool for breeders, geneticists, and agronomists. CRC Press, Boca Raton, FL.
- Yan, W., Hunt, L.A., Sheng, Q. and Szlavnic, Z. 2000. Cultivar evaluation and mega-environment investigation based on the GGE Biplot. *Crop Science* 40:597-605.

استخدام طريقة المحاور الثنائية لإجراء مقارنة بين الأصناف التجارية والسلالات المستقبلية للقطن في الأراضي المستصلحة حديثاً
عادل أبو اليزيد الأخضر، عبد الناصر محمد رضوان عبد الباري، هشام مسعد حمود و
محمد عبد الفتاح أبو اليزيد
معهد بحوث القطن - مركز البحوث الزراعية

اجريت هذه الدراسة في موسمي ٢٠٠٩ و ٢٠١٠ وذلك لإجراء تقييم للأصناف التجارية والسلالات المبشرة من القطن في الأراضي المستصلحة حديثاً تحت نظام السرى بالتنقيط. وتم استخدام الأشكال البيانية لطريقة GGE Biplot لدراسة التباين والاختلافات بين التركيب الوراثية المستخدمة. وقد وجد ان الأصناف والسلالات التابعة لطبقة الاقطان طويلة وجة بحري كانت الأفضل في صفات المحصول في حين ان الأصناف والسلالات التابعة لطبقة الاقطان فائقة الطول تميزت في الصفات التكنولوجية فيما عدا التركيب الوراثي جيزة ٨٤ X ب س ٦ حيث كان مناس قوي ايضاً لطبقة طويل بحري في صفة تصاقى الحليج. للتساق اشارت ايضاً الى ان التركيب الوراثي ١٠٢٢٩ X جيزة ٨٦ كان الأفضل تحت هذه الظروف لكل من صفة محصول القطن الزهر والشعر في حين ان الصنف جيزة ٨٦ كان الأفضل لصفة تصاقى الحليج بينما كان التركيب الوراثي جيزة ٧٧ X ب س ٦ متميزاً لصفة طول التيلة وكان كلا من التركيب السوراثي جيزة ٨٨ والتركيب الوراثي جيزة ٨٤ X ب ٦٢ الأفضل لصفة متانة التيلة. ولقد كانت التركيب الوراثية المصدر الاكثر اهمية للتباينات حيث تراوحت بين ٥٣.٧٣ % لصفة طول التيلة و ٩٢.٥ لصفة متانة التيلة.

قام بتحكيم البحث

كلية لزراعة - جامعة المنصورة
مركز البحوث الزراعية

أ.د / ممدوح محمد عبد المقصود
أ.د / عبد المعطي محمد علي زينه