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The Study of the Mutual Effect of Genotype in Environment by Percent of Oil Criterion in Sunflower

Seyed Mohammad Nasir Mousavi, Pasha Hejazi, Maryam Ebrahimian Dehkordi

***Abstract*—**In order to study the Mutual effect of genotype × environment for the percent of oil index in sunflower items, an experiment was accomplished form complete random block designs in four iteration and was four diverse researching station comprising Esfahan, Birjand, Sari, and Karaj. Complex variance analysis showed that there is an important diversity between the items under investigation. The results relevant the coefficient variation of items Azargol and Vidoc has respectively allocated the minimum coefficient of variations. According to the results extrapolated from Shokla stability variance, the Items Brocar, Allison and Fabiola, are among the stable genotypes for oil percent respectively. In the biplot GGE, the location under investigations divided in two super-environments, first one comprised of locations naming Esfahan, Karaj, and Birjand, and second one were such a location as Sari. By this point of view, in the first super-environment, the Item Fabiola and in the second Almanzor item was among the best items and crops.

***Keywords*—**Sunflower, Stability, GGE biplot, Super-Environment.

I. Introduction

ONE of the eugenic objectives in the related programs, is to generate the crops items with high functionality and stability. The effective agent in the stability of genotypic function is the mutual effect between genotype and environment conditions, in another word, the grading and ramification of various genotypes in diverse environment conditions [1]. Peterson and his colleges stated that there may be some observable discrepancies in functionality, in which they called this subsequent result, the mutual effect of genotype × environment [5]. This mutual effect is applied to the situations where diverse and various genotypes reflect in relation to the different environmental reactions [2]. If the genotypic functionality became stable in a range of environmental situations, the mutual effect of genotype × environment will never have place or no time to be seen and to appear. If functional ranking of these genotypes becomes stable in a domain of the environmental conditions, there will be no mutual genotype × environmental effect to be recorded down [6].

Genotype × Environment Interaction (GEI) is an important aspect of plant breeding programs. It may arise when certain genotypes are grown in diverse set of environments. A significant G × E interaction for a quantitative trait such as seed yield can seriously limit the efforts on selecting superior genotypes for both new crop production and improved cultivar development [3].

The GGE biplot can effectively identify the GE interaction pattern of the data. It clearly shows which cultivar won in which environments, and thus facilitates mega-environment identification. Therefore, multi-site trials conducted over years are essential for addressing the mega-environment issue. Ideal cultivars should have a large PC1 score (high yielding ability) and a small (absolute) PC2 score (high stability). Similarly, ideal test environments should have a large PC1 score (more discriminating of the genotypes in terms of the genotypic main effect) and small (absolute) PC2 score (more representative of the overall environment) [7], [8].

II. Materials & Methods

To study and probe on the stability of the sunflower items, there we selected and prepared 16 genotypes of it (sunflower) (these species were: Alexandra, Joana, Fabiola, Euroflor, Brocar, Azargol, Arena, Altesse, Almanzor, Alisson, Vidoc, Terra, Pomar, Nkarmoni, Melody, Mas96a) from the investigation on Eugenic of seeds and sapling in Karaj and began a comparable procedure in the form of full random design blocks in 4 iterated measure in 4 regions, Esfahan, Birjand, Sari and karaj and in the cultivation year 2011-2012 . The preparation operations of lands included of cleaning of floor (ground), plowing, disk, tabulation, and making gutters and stacks. Every experimental Kurt was formed of 4 rows of plant cultivation with 5 meters long and 80 centimeters width, the distance of bushes was determined 20 centimeters. Amount of the applied seeds was 6 Kilograms in hectare (60 bushes in every squared meter). On the way to eradicate weeds, there we used a mechanical method in all the cultivation running periods until attaining harvest time, and then we used cultivation caregiving support. Finally, all the karts were harvested by hand. Generally, the attributes of oil percent was noted in all time spared on the experiment. For the purpose of statistical analyses, first, we applied variance analyses for every region separately and then, the final complex variance implemented. These analyses were operated

Seyed Mohammad Nasir Mousavi, Department of Agronomy and Plant Breeding, Karaj Branch, Islamic Azad University, Karaj, Iran (phone: +989124715766; e-mail: Nasirmousavi@gmail.com).

Pasha Hejazi, Department of Agronomy and Plant Breeding, Karaj Branch, Islamic Azad University, Karaj, Iran (e-mail: pasha.hejazi@gmail.com).

Maryam Ebrahimian Dehkordi, Department of Agronomy and Plant Breeding, Karaj Branch, Islamic Azad University, Karaj, Iran (e-mail: ebrahimian.mariam@gmail.com).

by means of SAS, GGEbiplot software and also to analyze pertaining stability statistics gathered, we used NSTAB software.

III. Results

A. Results Obtained from Variance Analyses

Results attaining from compels variance analyses to determine the oil percent in the specimen revealed that, the location effect on this important index had been meaningful in a definite level of oil. In addition, these complex analyses for the above-mentioned regions under investigation showed that the effect of item (species) in probability level is a meaningful percent. This observable meaningfulness of the item shows that experimental items reaction in all the regions had not been identical. Either, the mutual genotype × location in the probability level owned a meaningful percent for the oil extractable. To become meaningful genotype × location mutual effect, shows that all the experimental items reaction had the same value in various regions. In another word, the genotypes responses were different from one place to another one. With regard to have different effect in the context of mutual effect between genotypes and environment, the variance analysis usually is not capable to justify the stability of them (genotypes), so it is necessary to apply statistical methods in analyzing the genotype versus environment, by the way to introduce the stable genotypes (Tables I, II).

TABLE I
Mean Squares from Analysis of Variance for Grain Yield of Sunflower Genotypes and Four Regional

		(MS)			
(S.O.V)	(df)	Sari station	Karaj station	Esfahan station	Birjand station
Block	3	39.33*	92.67*	3.37^{ns}	31.46*
Cultivar	15	707.551**	263.532**	356.934**	243.2007**
Erorr	45	140.195	206.687	59.880	59.046
CV%		3.19	4.16	2.44	2.32

*, ** And Ns: Respectively, Indicating A Significant Difference in the Level of 1%, 5% and No Significant Difference.

TABLE II
Combined Analysis of Variance of Sunflower Varieties in Four Locations

(S.O.V)	(DF)	(SS)	(MS)
Station	3	2181.462	727.154**
Erorr	12	166.854	13.904
Genotype	15	955.478	63.698**
G×E	45	615.741	13.683**
Erorr	180	465.809	2.587
Total	255	4385.345	
CV%		10.54	

*, ** And Ns: Respectively, Indicating A Significant Difference in the Level of 1%, 5% and No Significant Difference.

B. The Results Obtained from Stability Analysis

The changing coefficients (*cvi)* were used for determination the stability of genotypes. The results in relation with changing coefficient showed that the Vidoc and Azargol items allocated the minimal changing coefficients to themselves. Hence, they had biological stability with high amount of flexibility. Francis and Kannenberg by applying the mean function and amount of changing coefficients of each item determined their corresponding locations in the coordination axes and based upon these data, they also divided them into four groups [2]. The best and most appropriate item were the ones in which were designated in same groups. With bearing this in mind, genotypes located in same regions, are the best ones by this method. Therefore, based upon the Fransis and Kannenberg method, here the items Fabiola, Euroflor and Altesse are the stable genotypes. In addition, the items Melody, Joana, and Pomar had the most amounts of the changing coefficients respectively, and in this regard, had the lowest amount of stability. The variance stability statistics Shokola (σ_i^2) and Rick Echo valence (w_i^2) implied the second kind of variance based on Lin and Binns his associates ramification method [4]. according the results obtained from Shokla variance stability items Brocar, Allison and Fabiola, based on their lowest amount of Shokola variance were among the stable genotypes detected (Table III).

TABLE III
Methods Based on Results of Univariate Analysis of Variance for Genotypes of Sunflower

Number	Genotype	Yield Oil Average	Coefficient of variation with in spatial	CV	E.Ric	Variance Stability
1	Alexandra	51.17	10.80	9.04	7.45	4.12
2	Alisson	51.22	8.36	7.09	0.14	-0.15
3	Almanzor	54.44	0.41	9.16	8.41	4.68
4	Altesse	51.04	13.84	5.42	10.09	5.67
5	Arena	49.93	13.77	8.39	1.69	0.75
6	Azargol	49.96	27.98	4.07	44.23	25.69
7	Brocar	49.55	16.35	6.94	0.11	-0.17
8	Euroflor	52.57	5.12	6.008	8.55	4.17
9	Fabiola	53.72	2.49	6.007	0.41	0.0007
10	Joana	48.62	21.57	8.71	1.55	0.67
11	Mas96a	48.50	22.44	7.49	1.29	0.51
12	Melody	47.88	26.62	9.40	2.62	1.29
13	Nkarmoni	52.67	3.10	8.92	5.20	2.81
14	Pomar	49.45	17.82	8.51	1.44	0.60
15	Terra	52.99	2.68	7.45	0.77	0.21
16	Vidoc	49.17	21.93	4.60	5.96	3.25

C. The Stability Analyzing Results Based on Regression Methods

In the Finely and Wilkinson method, items that their relational regression coefficient is near or equals 1, have intermediate stability and their corresponding function is higher than intermediate have weak general compatibility. So, in this research, the Fabiula item by having regression coefficient near one and also owing a notable function higher than intermediate, are designated by good general compatibility. In addition, Melody item with a lower regression coefficient and lower functional mean amount lower than intermediate, have undesired general stability and compatibility respectively.

Among the other regression methods, the Hansson models, with lower amount of Di, have lower deviation value and more stability amount. In this research, Allison and Pomar species by owing the lowest values of D_i were known as most stable

genotypes and with respect to mean functional value, it is possible to recognize Allison item as most stable genotypes that have high amount of oil feature. According to definition, the items Euroflor and Fabiola are among most unstable genotypes (Table IV).

TABLE IV
FINLAY AND WILKINSON REGRESSION PARAMETERS FOR THE STABILITY OF SUNFLOWER HYBRIDS

Number	Genotype	Yield oil Average	(D^2)	(R_i^2)	(b_i)
1	Alexandra	51.17	6.55	0.861	1.27
2	Alisson	51.22	5.83	0.999	1.07
3	Almanzor	54.44	6.43	0.901	1.40
4	Altesse	51.04	6.66	0.550	0.60
5	Arena	49.93	5.90	0.985	1.23
6	Azargol	49.96	6.56	0.273	-0.31
7	Brocar	49.55	5.85	0.995	1.01
8	Euroflor	52.57	6.71	0.633	0.74
9	Fabiola	53.72	5.88	0.982	0.94
10	Joana	48.62	5.85	0.996	1.25
11	Mas96a	48.50	5.99	0.951	1.05
12	Melody	47.88	5.86	0.995	1.33
13	Nkarmoni	52.67	6.15	0.943	1.35
14	Pomar	49.45	5.84	0.997	1.24
15	Terra	52.99	5.85	0.995	1.16
16	Vidoc	49.17	6.12	0.773	0.59

IV. GENOTYPES STABILITY ANALYSIS WITH THE AID OF MULTI-VARIABLE AND GGE BIPLOT GRAPHICS IN PERCENT OF SUNFLOWER OIL SPECIES

A. Determination of Mega-Environment and the Best Item per Location

There observed a polygonal in the form of biplot that has created from the far most genotypes (in relation to origin of Bi plot) with regard to each other and gives comprehensive and detailed information. By applying of biplot and encircled polygonal inside it, we may recognize Mega-environments and the superior species for every location. In this biplot, we can see Sections V. Two Mega-environments are generated by means of the lines perpendicular to this sides of sections. The other genotypes are (except the ones located in apexes) according to necessity located in this polygonal. The Azargol, Fabiola, Almanzor, and Melody species are situated in the edge or apex of this polygonal form. The locations Esfahan, Karaj, and Birjand are in the section where, Fabiola genotype is located in apex of correspondingly. In reality, this is interpreted in such a way that Fabiola is the best genotype for the locations aforementioned. Sari location is situated in the section in which Almanzor genotype lies in its apex and means that genotype 3 is the best one for Sari location. Moreover, the Vidoc, Altesse, Azargol, Brocar, Pomar, Terra, Mas96a, Joana, and Melody genotypes are among the locations that there is no place situated in these sections. Another attribute or index of this biplot is reflectiveness of the categorization of environments. This denotes on the recognition of diverse Mega-environments. In this biplot that is based upon the average of genotypes, the fields Isfahan, Karaj and Birjand has constituted the first Mega-environment, also Sari has known as the second Mega-environment. The winning genotypes for every Mega-environment have been noted above (Fig. 1).

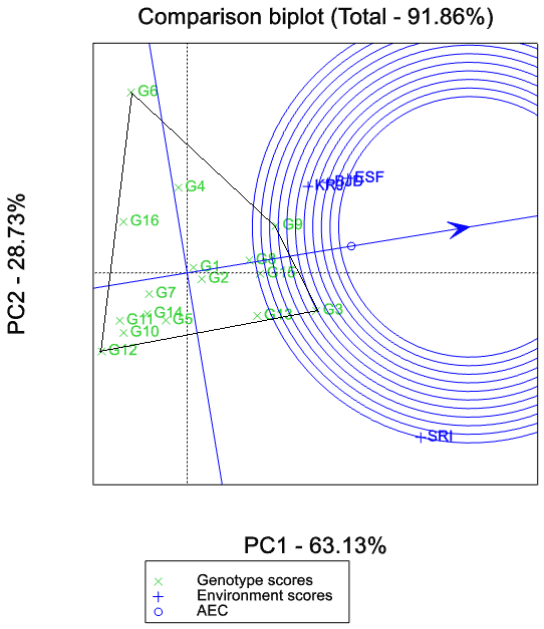

Fig. 1 Chart Polygon Method for the Determination of the Environmental GGE biplot in Sunflower Genotypes {SRI (Sari), KRJ (Karaj), ESF (Esfahan), BJD (Birjand): G1 -G16 Alexandra ،Alisson ، Almanzor ،Altesse ،Arena ،Azargol ،Brocar ،Euroflor ،Fabiola ، Joana ،Mas96a ،Melody ،Nkarmoni ،Pomar ،Terra & Vidoc}

B. The Mean Amount of Functionality and Genotypic in Stability

With the aid of Bi plot shown in the figure, it is evaluated the mean amount of functionality and genotypes related stabilities. In general, genotypes with location in positive side of horizontal axis, has more functionality with regard to the negative side. By notice to this form, Almanzor genotype has the most functionality and the Melody genotype has the least amount of it. The mean amount of the genotypic functionality is as follows:

3>9>15>8>13>2>1>4>5>7>14>6>16>11>10>12

Similarly, in addition to their low representing functionality, Melody, Azargol and Almanzor genotypes showed the most fluctuations (most instability), because they have got perpendicularly crossed the horizontal axis with the longest length of the line. Meanwhile, Terra, Euroflor, Alexandra and Alisson and after them Fabiola, Nkarmoni was determined as the most stable genotypes. although, Brocar, Altesse, and Mas96a showed a little bit of fluctuation behavior, but by point of this graph, and as a criterion for functionality they did not have good position and therefore , they have not been selected (Fig. 2).

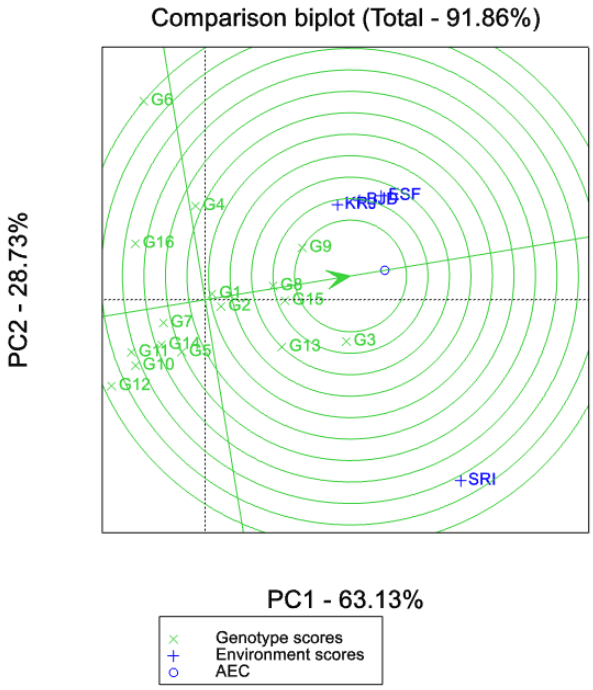

Fig. 2 The Rankings Are Based On The Ideal Environments For Yield: {SRI (Sari), KRJ (Karaj), ESF (Esfahan), BJD (Birjand). G1 - G16 Alexandra ‹Alisson ‹Almanzor ‹Altesse ‹Arena ‹Azargol ‹ Brocar ‹Euroflor ‹Fabiola ‹Joana ‹Mas96a ‹Melody ‹Nkarmoni ‹ Pomar ‹Terra & Vidoc}

V. Conclusion and Proposals

In the current research and with the application of the stability statistical analyzing methods, also with the aid of regression procedures and multi-variable items of Almanzor, Fabiol, Terra and Euroflor had been declared as the desirable items by the scope of functionality and stability.

It is highly recommended to use the stable items and species in the Eugenic confluences and, for more study and research objectives, these phenomena should be probed in the farmer's conditions. It is better for the items under study in the other investigation projects to study the functionality stability, get to be scanned and testing in various years as well as diverse locations.

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