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Research Article

Yield Stability on Oil Percentage in Sunflower Hybrids in Iran

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Abstract

In order to determine the stability of oil percentage of sunflower cultivars, a randomized complete block design with four replications was conducted in four research stations in Isfahan, Birjand, Sari and Karaj. Combined variance analysis showed that there was considerable variation among the cultivars in terms of oil percentage. The coefficient of variation for oil percentage of Azargol and Vidoc had the lowest coefficient of variation, respectively. Fabiola, Euroflor, and Altesse cultivars were genotypes based on the Francis and Kannenberg method for oil percentage traits. Based on the results obtained from the Shukla stability variance, Brocar, Alisson and Fabiola cultivars were among the stable genotypes for oil percentage, respectively. Based on the regression coefficient, Brocar and Fabiola cultivars had a good overall consistency in terms of oil percentage. According to the AMMI1 chart, the oil content of Joana and Nkarmoni were more stable and more stable. In the AMMI2 chart, Pomar, Fabiola, Arena and Brocar and Birjand locations were recognized as the most stable cultivars and locations for oil percentage. In the GGE bi-plot method, the locations were divided into two mega environments, the first mega environment of Isfahan, Karaj, and Birjand locations and the second mega environment including Sari. In terms of this trait, in the first cloud of the first Fabiola variety, and in the second medium, the Almanzor cultivar was the best cultivar.

Keywords: Sunflower; Stability; GGEbi-Plot; AMMI; Mega Environments

Introduction

The arrival of the sunbathing in Iran coincided with the First World War, narrated by Russian soldiers and narrated by Iranian merchants and Caucasian Warmini, and the cultivation area of this plant in the regions near the Russian border was mainly Khoy, Marand and Meshkin Shahr. This has consumed the eating. With the beginning of the activity of the oilseed development company in 1346, oilseed cultivation started with a cultivar of 1719 hectares and produced 1447 tons of seeds in the first year [1].

Yan., *et al*. [2] used the GGE bi-plots, where the genotype and GE interaction effects are two sources of relevant variability and are taken into account simultaneously at the time of selection of superior cultivars. The multiplicative models are useful when studying the GEI but do not allow the incorporation of environmental covariates. Another approach used to study the GEI has been the use of stability index, including Finlay-Wilkinson regression models proposed by Finlay and Wilkinson [3]. This index, that determines the stability of different cultivars through various evaluation environments, has shown successful results in several species, including sunflower [4].

Mousavi., *et al.* [5] showed that the coefficient of variation for grain yield Nkarmoni and Brocar cultivars are biological stability and a high degree of flexibility. Terra, Vidoc and Alisson Cultivars were stable respectively, according to the minimum variance Shukla, among varieties for grain yield. Based on the regression coefficient Fabiola and Arena Cultivars were average yield stability and adaptation Suitable. According to the graph AMMI1 of the function and stability Nkarmoni was higher than the other varieties. AMMI2 figures in the chart Euroflor, Alisson, Mas96a and Fabiola in Birjand place were identified yield stable part numbers and locations. GGE bi-plot method on grain yield was studied areas were divided into mega- environments, first mega- environments were included Isfahan and Sari places and second mega- environments were Birjand and Karaj places in terms of yield, Isfahan, Karaj and Birjand were varieties best.

In multi-environment experiments, beside the primary trait, significance of other characteristics is also identified [6]. However, GGE bi-plot graphs should accurately and efficiently be interpreted along with the objectives of the study. In silage maize, beside silage yield, the other plant characteristics may also vary with environmental conditions. The plant characteristics to be used in variety selection in maize to be cultivated in different environments of target region should be determined before to design a study on maize cultivars. However, there are not studies in literature assessing silage yield and yield characteristics of several maize genotypes under different environments. In present study, Genotype × Trait (GT), Environment × Trait (ET) and Trait Association × Environment (TAE) of different plant characteristics of 25 silage maize genotypes grown in six environments were assessed through GGE bi-plot analysis. Study investigating different plant characteristics of maize genotypes in different environments that stem diameter, green leaf weight ratio and plant height were identified as the mostly correlated traits with silage yield in all environments. GGE bi-plot method allowed efficient and reliable assessment of investigated traits in different environments. With this method, how a trait changed in each environment was identified, how traits are correlated with each other in each environment was assessed and the environments contributing the assessment of maize genotypes were identified. It was also concluded that GGE bi-plot method could reliably be used in assessment of different characteristics of silage maize genotypes grown in different environments [7].

Results indicate that the pattern of the polygon view traits varied across three years. Consequently, GT bi-plot describes the interrelationships among traits and it was used to identifying hybrids that are good for some particular traits [8].

Materials and Methods

So as 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, the preparation operations of lands included of cleaning of floor (ground), plowing, tabulation and making gutters and stacks. Every experimental 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 experiment was harvested by hand. Generally, the attributes of oil percent were noted in all time spared on the experiment.

To measure the percentage of oil, the test material was packed in separate packages and labeled for each genotype on the oily bean lab and measured in the laboratory according to the existing protocol.

For the purpose of statistical analyses, first of all we applied variance analyses for every region separately and then, the final complex variance implemented. These analyses were operated by means of SAS, GGE Bi-plot software and also to analyze pertaining stability statistics gathered, we used NSTAB software.

Result

Simple and compound analysis of variance and comparison of mean genotypes

After controlling the normality of the data, the uniformity of the variance of the test errors was performed using the Bartlett test. In analysis of separate variances (Table 1), there was a significant difference between genotypes in Isfahan, Birjand, Sari and Karaj locations at the probability level of one percent.

S.O.V	DF	Birjand	Esfahan	Karaj	Sari
Block	3	31.467*	3.371ns	92.679*	39.336ns
Genotype	15	243.2007**	356.934**	263.532**	707.551**
Error	45	59.046	59.880	206.687	140.195
CV%		2.32	2.44	4.16	3.19
Ns,*, ** Respectively, showed significant differences in the level of no significant difference, 0.05 and 0.01.					

Table 1: Average squares of simple analysis of variance of oil content of studied sunflower genotypes in four regions.

The results of compound analysis of variance for oil percent showed that the effect of place for oil percentage was significant at 1% level (Table 2). Therefore, the percentage of sunflower oil varies from place to place. This also suggests the usefulness of sustainability analysis for this trait.

S.O.V	DF	SS	MS
Location	3	2181.462	154.727**
Error	12	166.854	13.904
Genotype	15	955.478	63.698**
Location*Genotype	45	615.741	13.683**
Error	180	465.809	2.587
Total	255	438.345	
CV: 3.16			
Ns,*, ** Respectively, showed significant differences in the level of no significant difference, 0.05 and 0.01.			

Table 2: Combined analysis of variance of sunflower genotypes at 4 stations.

Combined analysis of variance for studied regions showed that the effect of cultivar is significant at 1% probability level. Significance of the cultivar effect indicates that there is a genetic difference between the tested genotypes. Also, genotype × location interaction was significant at 1% probability level. Significance of interaction of genotype × location showed that the reaction of experimental cultivars was the same in different regions. In other words, the response of genotypes varies from place to place. Regarding the existence of interaction between genotype and normal variance analysis environment, it is not possible to justify the stability of genotypes. Therefore, it is necessary to analyze the genotype and environment interaction by using statistical methods to introduce sustainable genotypes.

Results of environmental variance method and coefficient of variation

The coefficient of variation was also used to determine the stability of genotypes. The coefficient of variation showed that Azargol and Vidoc had the lowest coefficient of variation. It therefore has a biological stability and is highly flexible.

Results of the method of stability and rice Ecovalance variance

Francis and Kannenberg [9], using the mean performance and the coefficient of variation of each cultivar, determined their location in the coordinate axis and divided it into four groups. The best and most suitable are the ones in group one. In this regard, in Figure 1, the genotypes located in zone 1 are the best genotypes in this method. Thus, the cultivars Fabiola, Euroflor and Altesse are genotypes based on the Francis and Kannenberg method. Also, Melody, Joana and Pomar cultivars had the highest coefficient of variation, respectively, showing the lowest stability (Table 3, Figure 1).

Genotype	Average Yield	Sustainability variance	Ecovalance Rick	Coefficient of variation	In-spatial variation coefficient
Alexandra	51.17	4.12	7.45	9.04	10.80
Alisson	51.22	-.015	0.14	7.09	8.36
Almanzor	54.44	4.68	8.41	9.16	0.41
Altesse	51.04	5.67	10.09	5.42	13.84
Arena	49.93	0.75	1.69	8.39	13.77
Azargol	49.96	25.69	44.23	4.07	27.98
Brocar	49.55	-0.17	0.11	6.94	16.35
Euroflor	52.57	4.17	8.55	6.008	5.12
Fabiola	53.72	0.0007	0.41	6.007	2.49
Joana	48.62	0.67	1.55	8.71	21.57
Mas96a	48.50	0.51	1.29	7.49	22.44
Melody	47.88	1.29	2.62	9.40	26.62
Nkarmoni	52.67	2.81	5.20	8.92	3.10
Pomar	49.45	0.60	1.44	8.51	16.82
Terra	52.99	0.21	0.77	7.45	2.68
Vidoc	49.17	3.25	5.96	4.60	21.93

Table 3: Results of univariate methods based on analysis of variance for studied sunflower genotypes (oil Percentage).

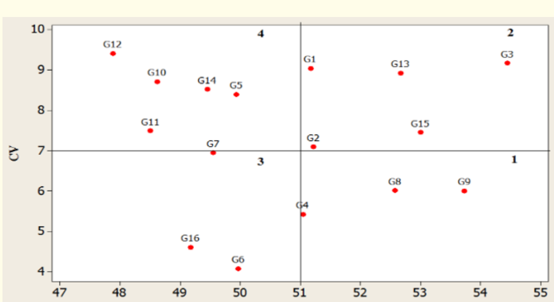


Figure 1: Distribution pattern of sunflower genotypes in terms of oil percentage and coefficient of variation.

Results of stability variance and Rick Ecovalance

The equilibrium statistics of Shukla and Rio Ecovalance indicate the sustainability of the second type of Lane., *et al.* [11]. Based on the results obtained from the Shukla stability variance, Brocar, Alisson and Fabiola cultivars are considered as stable genotypes, due to having the lowest amount of Shukla variance (Table 3). Also, Azargol, Altesse and Euroflor are introduced as low-yielding cultivars. In order to determine the contribution of each genotype to the sum of squares, the interaction between the genotype × environment and its calculation as a stability statistic, the Rick ecovalance was calculated (Table 3). The results of the Shukla stability equation rating and Rick's equation showed that these two statistics are similar, and one of these two parameters may be preferred.

The results of the lin and bains method

Lin and Binns (1988) proposed the mean squares of the interspace years. They separated the agent from the calculation of sustainability. The results of the inter annual variance and in-line variation coefficient Lin and Bins (1991) as the fourth-order parameter are presented in Table 3. Based on these methods, Almanzor, Fabiola and Terra cultivars had the least amount of variance and the lowest coefficient of inter-modification in both methods and were recognized as the most stable genotypes, respectively.

Stability analysis of genotypes based on regression analysis (Type II and III statistics) Finley and Wilkinson's method

Figures in which the regression coefficient is close to or equal to 1 has a moderate stability, and if their performance is above average, they are generally well-matched. And if their performance is less than average, they are generally poorly adapted. Therefore, in this study, Brocar and Fabiola cultivars have a good regression coefficient of close to one and higher yields than moderate, with good stability and general consistency. Mas96a has a regression coefficient of close to 1 and performance is lower than medium with moderate stability and poor overall compatibility. Also, the Brocar cultivar with a regression coefficient of close to one and the average performance of the near-average are of moderate stability and moderate general consistency (Table 4).

Genotype	Average yield	Regression Coefficient (b_i)	Detection coefficient (R_i^2)	Henson (D^2)
Alexandra	51.17	1.27	0.861	6.55
Alisson	51.22	1.07	0.999	5.83
Almanzor	54.44	1.40	0.901	6.43
Altesse	51.04	0.60	0.550	6.66
Arena	49.93	1.23	0.985	5.90
Azargol	49.96	-0.31	0.273	6.56
Brocar	49.55	1.01	0.995	5.85
Euroflor	52.57	0.74	0.633	6.71
Fabiola	53.72	0.94	0.982	5.88
Joana	48.62	1.25	0.996	5.85
Mas96a	48.50	1.05	0.951	5.99
Melody	47.88	1.33	0.995	5.86
Nkarmoni	52.67	1.35	0.943	6.15
Pomar	49.45	1.24	0.997	5.84
Terra	52.99	1.16	0.995	5.85
Vidoc	49.17	0.59	0.773	6.12

Table 4: Stability parameters of finely and Wilkinson regression method for sunflower cultivars (oil percentage).

Detection or explanation coefficient method

Other regression models are the coefficient of explanation (or diagnosis) that is suggested for improving decision making based on regression model. The higher the coefficient of explanation, the more valid the regression model is. Using this method, Alisson, Pomar and Joana cultivars with the highest coefficient of variation were introduced as the most stable genotypes (Table 4).

Henson Model (Di2)

Other models of regression model of Henson model, which are less in this method, the deviation from the stable average is less and the stability of the cultivar is higher. In this study, Alisson and Pomar cultivars were identified as the least stable cultivars and with Due to the average yield, Alisson variety can be identified as the most stable genotypes with high oil content. According to the definition of this model, Euroflor and Fabiola cultivars were introduced as the most unstable genotypes.

Stability analysis of genotypes using multivariate and graphical GGE bi-plot method in oil percentage of sunflower cultivars

Determining the Mega environments and the best number in each location

In the bipolar of Figure 2, there is a polygon that is created by connecting the farthest genotypes (from the bipolat origin) to each other and provides comprehensive and detailed information. Using this biplane and polygon inside it, you can identify super paces and top-level genotype for each location. In this bi-plot (Figure 2), 4 sections and 2 clouds are visible by lines that are perpendicular to the sides of this polygon. Places are necessarily located inside these sections. Other genotypes (other than genotypes located at the vertices) are necessarily located within this polygon. The Azargol, Fabiola, Almanzor, Melody genotypes are located in the corners or vertices of this polygon. The places of Isfahan, Karaj and Birjand are located in the section, where the Fabiola genotype is at the top of that section. In fact, it is interpreted that Fabiola genotype is the best genotype for Isfahan, Karaj and Birjand. Searings are located in the part where the Almanzor genotype is at the top of that section, which means that genotype 3 is the best genotype for the sari location. Also, Vidoc, Altesse, Azargol, Brocar, Pomar, Terra, Mas96a, Joana and Melody genotypes are located in parts where there is no place in those areas. Another feature of this bi-platform is the grouping of environments. This refers to the identification of different mega environments. In this bi-plot based on the average genotypes, the places of Isfahan, Karaj and Birjand formed the first mega of the environment, and Sari was also known as the second Mega environments. The winning genotypes are mentioned for each cloud of the above.

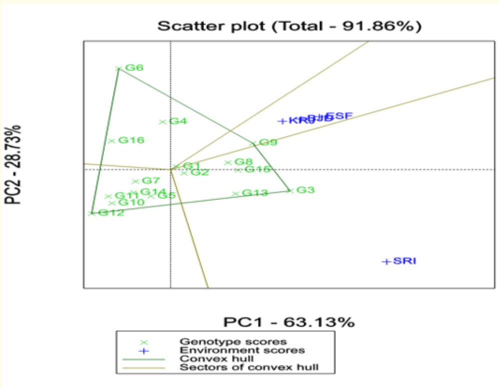
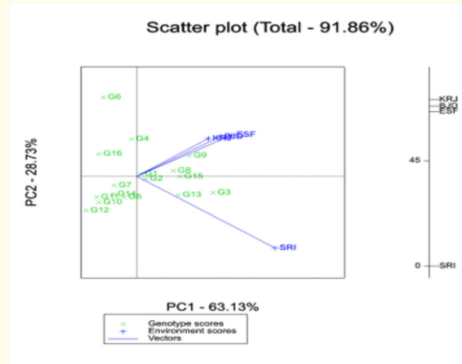


Figure 2: Polygon diagram for determining the Mega environment by GGE bi-plot method in sunflower genotypes in oil percent (SRI, KRJ, ESF, BJD, Birjand, Isfahan, Karaj and Sari, G1 to G16, Alexandra, Alisson, Almanzor, Altesse, Arena, Azargol, Brocar, Euroflor, Fabiola, Joana, Mas96a, Melody, Nkarmoni, Pomar, Terra and Vidoc).



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Examining the relationships between environments using the GGEbi-plot graphical method

Figure 3 depicts relationships and correlations between environments. In this diagram, the greater the angle between environment vectors, the greater the correlation between the environments. High correlation between environments means a high correlation between the ranks of genotypes in those environments. In general, the cosine of the angles shows the degree of correlation. Therefore, angles between vectors smaller than 90 degrees indicate a positive correlation between them. The angle of 90 degrees between the vectors also indicates the independence and lack of solidity of the environments. And if the angle of the vectors is greater than 90 degrees, it means a negative correlation between those environments. In this diagram, as shown, there is a high correlation between places of Karaj, Isfahan and Birjand, due to the low angle, which means the same response to genotypes in these locations. The locations of Karaj, Isfahan and Sari also showed correlation near zero, in other words, the genotypes in this pair of places had an independent process. In this research, the locations of Isfahan, Karaj and Birjand were closely correlated. Therefore, it is suggested that one of these three locations be used to reduce the cost of testing for future research.

Average yield and stability of genotypes:

By using the bi-plot of Figure 4, the average yield and stability of genotypes were evaluated. Generally, genotypes positioned in the positive direction of the horizontal axis have a higher yield than the negative side of this axis. According to this form, Almanzor genotype showed the highest yield and Melody genotype showed the lowest yield.

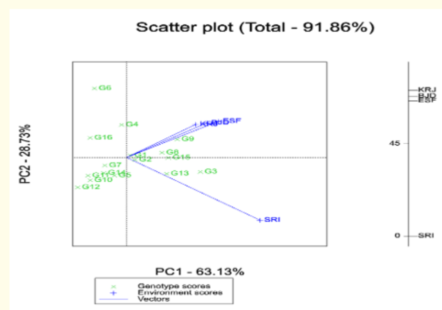

Figure 3: Relationship between environments by GGE bi-plot method in oil percentage (SRI, KRJ, ESF, BJD, Birjand, Isfahan, Karaj and Sari, G1 to G16, Alexandra, Alisson, Almanzor, Altesse, Arena, Azargol, Brovar, Euroflor, Fabiola, Joana, Mas96a, Melody, Nkarmoni, Pomar, Terra and Vidoc).

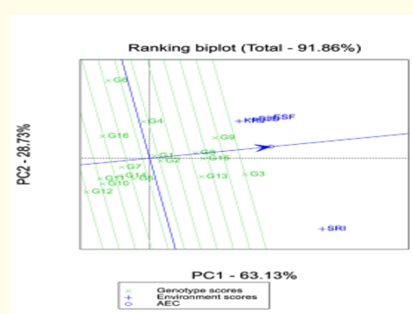

Figure 4: Average yield and stability of genotypes for oil percentage. SRI, KRJ, ESF, BJD Birjand, Isfahan, Karaj and Sari respectively and G1 to G16 Alexandra, Alisson, Almanzor, Altesse, Arena, Azargol, Brocar, Euroflor, Fabiola, Joana, Mas96a, Melody, Nkarmoni, Pomar, Terra and Vidoc).

The average yield of genotypes is as follows

12 <10 <11 <16<6 <14 <7 <5 <4 <1 <2 <13<8 <15 <9 <3 Also, Melody, Azargol and Almanzor genotypes showed, in addition to low yields, the highest yield oscillation (highest instability), since they were perpendicular to the longest line of the horizontal axis. While the genotypes Terra, Euroflor, Alexandra and Alisson were the most stable genotypes after the Fabiola and Nkarmoni genotypes. Although the Brocar, Altesse and Mas96a genotypes showed a quantitative fluctuation, they were not considered to be in a good position in terms of performance, so they were not selected.

Determining the ideal genotype using the GGEbi-plot graphical method

An ideal genotype with a high performance and high stability mean. The central center of the dashboard (Figure 5) is where the most ideal genotype can exist. Due to the fact that the center of the center of the center of the center of the hub is the most stable location of the genotype, it is plotted with a zero distance according to the Y axis. That is, it is completely stable and the vector of the ideal genotype on the X-axis is equal to the largest vector of genotypes, and shows the highest performance. Therefore, genotypes that are close to the ideal genotype are introduced as superior and ideal genotypes. Accordingly, the Fabiola, Almanzor and Terra genotypes are the closest genotypes to the bi-plot center and are recognized as the most ideal genotype. After this, the genotypes Euroflor and Nkarmoni were recognized as ideal genotypes. Almanzor genotype was also recognized as stable genotypes in most of the methods, and in this method, like most classical methods and AMMI method, they were in good condition. Azargol, Mas96a, Melody and Joana genotypes were identified as the most unfavorable genotypes based on this graph.

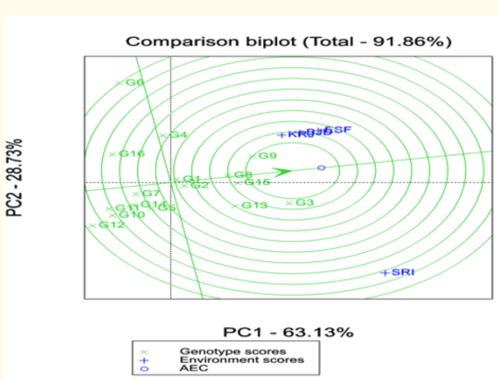

Figure 5: Determination of the ideal genotype with GGEbi-plot for oil percentage traits (SRI, KRJ, ESF, BJD, Birjand, Esfahan, Karaj and Sari, G1 to G16, Alexandra, Alisson, Almanzor, Altesse, Arena, Azargol, Brocar, Euroflor , Fabiola, Joana, Mas96a, Melody, Nkarmoni, Pomar, Terra and Vidoc).

Determine the ideal environment using the GGEbi-plot graphical method

Figure 6 shows the ideal environment graph. Ideal environments have the widest recognition and representation capabilities among other environments. Accordingly, the locations of Isfahan, Birjand and Karaj (due to their proximity to the central center of the Divers) were identified from the 4 sites as ideal stations. Finally, as seen in this section, the sari location was declared to be the weakest station due to having the greatest distance from the center of the center axis. It should be noted that the ideal environment is an appropriate representative for genotyping (this, of course, does not reject the results of other environments). In fact, ideal environments show the most ideal genotype response pattern [11-14].

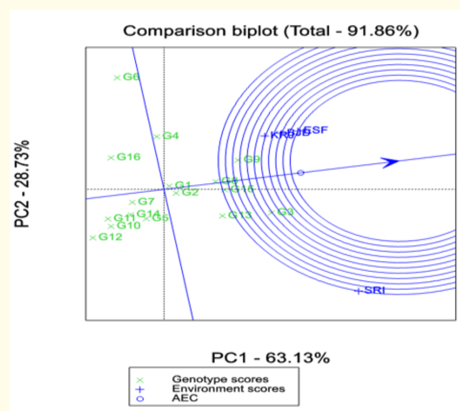

Figure 6: Determination of the ideal environment with GGE bi-plot for oil percentage (SRI, KRJ, ESF, BJD, Birjand, Isfahan, Karaj and Sari, G1 to G16). Alexandra, Alisson, Almanzor, Altesse, Arena, Azargol, Euroflor, Fabiola, Joana, Mas96a, Melody, Nkarmoni, Pomar, Terra and Vidoc).

Conclusion and Recommendations

In this experiment, the Azargol, Nkarmoni, Alexandra and melody figures for the oil percentage were found to be consistent and consistent. The Almanzor, Fabiola, terra and Euroflor varieties as well as consistent and consistent cultivars are also included in this test for oil percentage.

It is suggested

1. Use consistent cultivars in corrective crossings.
2. For further study, examine the conditions of farmers.
3. Figures in other studies are used to check the yield and oil yield stability in different years and other locations.

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