Int.J.Curr.Microbiol.App.Sci (2017) *6*(7): 1835-1857

International Journal of Current Microbiology and Applied Sciences
ISSN: 2319-7706 **Volume 6 Number 7 (2017) pp. 1835-1857**
Journal homepage: http://www.ijcmas.com

Original Research Article https://doi.org/10.20546/ijcmas.2017.607.221

Molecular Characterization and Stability Analysis for Yield and its Components Traits in Soybean (*Glycine max* L.)

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Keywords

Soybean, Stability analysis, Yield and its components, RAPD-PCR analysis.

Article Info

Accepted:
19 June 2017
Available Online:
10 July 2017

A B S T R A C T

Seven soybean entries namely;(Crawford, Giza 21, Giza 22, Giza 35, Giza 82, Giza 83 and Giza 111) with different reaction for highly yielding, tolerance for salinity, water deficit conditions and resistance for diseases were evaluated under twelve environments through two years (2015, 2016 seasons), three locations (the farm of agricultural research in Mansoura city, Dakahlia Governorate, the farm of agriculture research center, Sakha station Kafr El-Sheikh governorate and the farm of national research Centre in Nubaria, Beheira Governorate, Egypt) in addition two planting dates (the first planting date was 15 may, while the second date was 1 June) to study the range of genetic stability, the behavior responsible for the persistence cultivar, the interactions between these cultivars and all different environments and their effect on some yield components, respectively. Stability analysis was done using data calculated obtained from plant height, first pod height, number of pods/plant, 1000-grain weight, number of grains/plant, grain weight/plant and grain yield/plant traits beside (Random amplified polymorphic DNA (RAPD) through using four primers for the previous seven cultivars. The final results revealed that mean square variances of (Genotypes x Environments), (Environments+(Genotypes x Environments), the linear components of (Environments) and (Genotypes x Environments) and pooled deviation were highly significant and detected that the genotypes; (Crawford, Giza 21, Giza 22, Giza 35, Giza 83, Giza 111) were the most genetic stability entries according to the results of stability analysis specially (bi, S^2di, R^2) and recommended for using it under different environments, while the cultivar (Giza 82) coming in the second rank. Heritability in broad sense was high in plant height, number of pods/plant and grain yield/plant traits which indicated that the environment effect on these traits through using the previous entries was very low with intension the genetic stability unlike the rest of traits studied. DNA Fingerprinting analysis was conducted to compare between the seven soybean entries using four primers namely; (OPC10, OPF-4, OPA-17, and OPG-5). The four primers recorded 12 amplicons, where 8 of them were polymorphic with 66.67% polymorphism, while 4 fragments were monomorphic. Cluster analysis divided the seven genotypes into two main clusters, where the first one contained the genotypes (2, 4), while the second cluster involved the rest of genotypes, respectively.

Introduction

Soybean or Glycine max is considering one of the most plant species belongs to the legume family. Soy is classified as oilseed and using in China for 5.000 years as food and pharmaceutical manufacturing. Soybean is classification the famous and most important plant on the world's level for food and industrial crops. It is distinguishing from the rest of the other types of pulses that contains all the necessary and essential the eight amino acids for the human body to manufacture protein. This makes it an excellent source of complete protein, especially for vegetarians in addition, it also has multiple medical benefits for humans such as flavonoids and that give flowers, vegetables, fruits featured and special color as well as they contain a powerful antioxidant and two subjects (Genistein, Daidzein) which linked to decrease the risks of breast cancer, cancer of the lining of the uterus, minimizes the acute symptoms for the age of menopause, helping to prevent hardening for the arteries of the heart, reducing the accumulation of fat and controlling blood pressure, helping to keep blood vessels in good condition, that protect the body damage from highly levels of (Free radical) and activates the immune system. Soybean seeds are using for food scale to feed animals, birds and give strong fodder which has nutritional value for cattle, in addition fertilizer for agricultural soil, as well as its using as a good food for humans by grinding seeds and mixing it with wheat flour to fill the food gap in wheat production. The seeds are soaked in water to give industrial milk and are also extracting oil from soybean seeds in culinary purposes mainly. The beginning of soybean cultivation was in 1970 with area does not exceed of 3,000 acres and the average production per acre was 300 kg. Thanks to research and extension efforts cultivated area has evolved, as productivity rose even Egypt became the first in the world in terms of productive excellence by 30% for the world average, and 20% for the united states the main producer of this crop. However, it has been observed in the past ten years reducing the cultivated area of soybeans in Egypt because higher production costs and firming acre production, and thus decreasing the yield per unit area. Therefore, research efforts are concentrating in addressing those problems and reached the possibility of reducing costs with 30%, increasing the yield per acre with 25% and achieved highly profits with 550 pounds per acre by two ways as follow:- First: the cultivation of new varieties of high production, resistance to cotton leaf worm , does not need to spray pesticides, which saves about 20% of costs in addition to reduce the severity of environmental pollution, increasing the number of beneficial insects and highly resistance for salinity, toxicity of heavy metals and water deficit conditions, This will only be achieved qualitative progress in the genotypes and varieties extracted from plant breeding, import, hybridization programs, selection and continue to evaluate these genotypes for several generations to get genetic constancy.

The second reason: reducing nitrogen fertilizer rates by making bacterial inoculation for seed in the time of agriculture, adding a booster dose only the amount of 15 kg nitrogen per acre in front of confidentiality irrigate which provides 10% of the costs, and thus can be directed huge amounts of nitrogenous fertilizer for other crops Legume, Thus the qualitative stability of the variety must be done in more than one location and under different circumstances in addition, giving the same yield and the same degree of resistance for diseases.

AbdEl-Salam *et al.,* (2010) exhibited stability analysis in five germplasm of snake Cucumber through studding six traits within five locations during three years and detected that environments (linear) were significant for

yield / plant, yield / Fadden, fruit diameter and fruit shape index.

Popovic *et al.,* (2013) detected the stability analysis in yield and quality traits in ten soybean entries during two seasons and showed that the cultivar (Valjevka) was recorded grain yield/plant higher than the entries (Afrodita and Balkan) in addition, the genotyped (Irina and Becejka) were recorded highly mean of grain yield in 2010 season.

Hamawaki *et al.,* (2015) estimated adaptability and stability analysis in 14 soybean entries through three locations and two seasons using toler and centroid methods. They revealed that the genotypes UFU-008 and UFU-0013 were assorted in special group (E) with a concave pattern of adaptability and stability in addition, the entries UFU-001, UFU-002, UFU-006, UFU-0010 and UFU-0011 were bespoken for using in the location (Brazilian Cerrado growing) as well as these cultivars were highly yielding potential.

Silva *et al.,* (2016) detected the stability and adaptability in 37 soybean entries during four regions and two seasons for yield components and oil content traits. They revealed that the highest mean values of grain yield and its components traits under different locations for the two seasons were exhibited in the entries (BRSGO204 (Goiânia) and BRSMG (Garantia), while the highest genotype for oil content under the same experiments was (BRSMG 760 SRR), which indicated that these cultivars were recorded high genetic stability and adaptability under many conditions. The aim of this study is trying to understand the effect of different environmental factors and their interactions on the stability for some yield traits of soybean entries through different experiments including three locations, two years, two growing dates and all interactions among them in addition, molecular characterizations for the previous selected genotypes under studying by using RAPD-PCR analysis to determine all genetic differences between them which responsible for highly score of grain yield and quality traits under any environmental conditions.

Materials and Methods

Seven Egyptian cultivars of soybean were planted in three locations under two different dates of growing during 2015 and 2016 seasons in a randomized complete block design with three replicates for each experiment. The three locations were (the farm of agricultural research in Mansoura city, Dakahlia Governorate, the farm of agriculture research center, Sakha station Kafr El-Sheikh governorate and the farm of national research Centre in Nubaria, Beheira Governorate, Egypt), respectively. The experiments were conducted from 15 may to 15 September during 2015 and 2016 seasons and the first planting date was 15 may, while the second date was 1 June during the two seasons. The Agricultural description of the seven soybean genotypes and the classification of soil, temperature and relative Humidity (%) in all experiments were shown in tables 1–3, respectively.

Soil analysis

Before conducting the experiments, soil samples were taken from different sites of all the experimental locations for the two planting dates during the two seasons. Each sample was taken from a depth of 0-30 cm. The chemical analysis was carried out for each soil extract 1:5 to estimate the soluble anions, cations and total dissolved salts (TDS). The electrical conductivity (EC) was estimated in the extract of the soil saturate paste. The procedure for preparation and measurements of the soil extract was taken according to the method of Black *et al.,* (1965) and the methods of Chapman and

Parker (1961) in addition, average temperature and relative humidity % were taken at the summer weather especially (may, June, July and September months) at the three locations for the two planting dates within the seasons (2015 and 2016). Traits Studied:- Seven morphological, yield and its components traits namely; plant height, first pod height, number of pods/plant, 1000-Grain weight, number of grains/plant, grain weight/plant and grain yield/plant were estimated in this study for all locations under all conditions of the two seasons (2015 and 2016) in soybean entries to know the degree of variety's constancy under all circumstances and this gives a good impression for the degree of genetic stability, localization and adaptation under the Egyptian conditions.

Stability analysis was carried out according to Eberhart and Russell (1966). Heritability in the broad sense was estimated for the former traits, as illustrated by Collins et.al. (1987) according to the following formula:-

$$H^2b\% = \delta^2g / (\delta^2g+\delta^2e) \times 100$$

Coefficient of variability values were estimated depends on phenotypic (P.C.V) and genotypic (G.C.V) variances according to Kehr and Gardner (1960) and Yassin (1973).

Molecular Markers

Extraction of DNA

The genomic DNA was extracted from fresh leaf of seven soybean lines (Table, 1) according to the protocol of Biospin plant genomic DNA extraction Kit (Bio basic).

PCR- Amplification of RAPD

Amplification reaction was carried out in 25µl reaction mixture contained 2µl of genomic DNA, 3µl of the primer, 2.5µl of 10X Taq DNA polymerase reaction buffer, 1.5 units of Taq DNA polymerase and 200 mm of each dNTPs. The following PCR program was used in a DNA Thermocycler (PTC-100 PCR version 9.0-USA). Initial denaturation at 94°C for 5 min, followed by 35 cycles of 94°C for 30 s, 42°C for 90 sec. for annealing temperature, 72°C for 90 Sec. and final extension at 72°C for 2 min. Products by RAPD- PCR were separated on 1.5% agarose gels in 1X TAE buffer and detected by staining with ethidium bromide according to Sambrook *et al.,* (1989). DNA ladder 100bp was used and PCR products were visualized by UV-transilluminator and photographed by gel documentation system, Biometra-Bio Documentations, the amplified bands were scored as (1) for presence and (0) for the absence of all studied rice according to gel analyzer protocol.

RAPD analysis

A set of four random 10-mer primers, (Table4) were used in the detection of polymorphism among seven soybean entries. These primers were synthesized at RAPD-PCR and carried out according to the procedure given by Williams *et al.,* (1990) with minor modifications.

Data handling and cluster analysis (Phylogenetic tree)

Data was scored for computer analysis on the basis of the presence or absence of the amplified products for each primer of the four RAPD primers. Pairwise components of the seven soybean genotypes based on the presence or absence of unique and shared polymorphic products, were used to determine similarity coefficients, according to Jaccard (1908). The similarity coefficients Dice (1945) were, then, used to construct dendrograms, using the unweighted pair group method with arithmetic averages (UPGMA) employing the SAHN (Sequential,

Agglomerative, Hierarchical and Nested clustering) from the NTSYS-PC (Numerical Taxonomy and Multivariate Analysis System), version 1.80 (Applied Biostatistics Program).

Results and Discussion

Variation and interaction

The results obtained in table (5) detected that all observed variations among all germplasm materials were highly significant for all traits studied indicating that the presence of a genetic variation with clearing and concreting form within all these genotypes. The mean squares differences of environmental were highly significant suggested that environments were contributed and developed largely on the genotypic performance realized. The interactions between genotypes and environments were highly significant for the seven traits studied which revealed that all entries were varied and different about their performance from a year to year, location to location, and from date of agriculture to another one.

For the mean squares of environments (Linear) and environments X genotypes (Linear), the results of stability analysis detected highly significant variances for all traits studied precisely in this direction which means that the differences between all environments factors (Locations, Years, Treatments) were high considerable influence on all genotypes and traits studied and the proof of these results the mean squares of the two linear types for all traits were not only highly significant differences but also higher than non-linear component and this increasing the possibility of highly production for soybean entries and highly stable under different environmental conditions (Table 5). The differences of mean square due to (environments + (Genotypes X Environments) were highly significant for all traits studied which exhibited that considerable interaction of all entries under different environmental conditions of years, locations and treatments in different years. The variances due to entries were showed to be highly significant for all the traits studied against pooled deviation which means the presence of sufficient genetic variability between the genotypes, Gill and Kumar (1989), Popovic *et al.*, (2013), Selvi *et al.*, (2015), Hamawaki *et al.*, (2015), Akter *et al.*, (2015)and Silva *et al.*, (2016).

The values of (F-Ratio) were significant and highly significant for all traits studied of the most of (S.O.V) components during the (ANOVA-Test) of stability analysis table (6), indicating and confirming the overall difference for all genotypes and environments used in twelve experiments and also confirming highly genetic stability for these entries from environment to another one.

Mean performance

There is no doubt that the genetic stability of the previous entries will be very important for the cultivar efficiency responsible for high yielding, tolerance for salinity and water stress, resistance for diseases under all environments, the level of success for the interactions between (Genotypes X Environments) and therefore the results obtained in tables (7, 8, 9, 10, 11, 12, 13) revealed that the genotypes (Giza 21, Giza 22, Giza 83, Giza 111) for plant height trait in table (7), (Crawford, Giza 21, Giza 22, Giza 83) for first pod height trait in table (8), (Giza 21, Giza 22, Giza 83, Giza 111) for number of pods/plant trait in table (9), (Crawford Giza 35, Giza 83, Giza 111) for 1000-grain weight trait in table (10), (Crawford, Giza 21, Giza 22, Giza 111) for number of grains/plant trait in table (11), (Crawford, Giza 21, Giza 83, Giza 111) for grain weight /plant and grain yield/plant traits in tables (12, 13) were the most entries recorded highly genetic stability

and were high excellence under the twelve environments (two years X three locations X two planting dates), while the rest genotypes were coming in the second rank in terms for the importance of genetic stability, respectively.

The results obtained in table (14), revealed that the soybean cultivars (Giza 22, Giza 83, Giza 111) for plant height, (Crawford, Giza 21, Giza 22, Giza 83) for first pod height, (Giza 21, Giza 22, Giza 111) for number of pods/plant, (Crawford, Giza 83, Giza 111) for 1000-grain weight, (Crawford, Giza 22, Giza 35, Giza 111) for number of grains/plant and (Crawford, Giza 21, Giza 83, Giza 111) for grain weight/plant and grain yield/plant traits were recorded the highest mean values for the previous traits studied, respectively. These results confirmed that adapting and suitability of these soybean entries under all conditions and a strong signal for their genetic stability for different environments studied or even all other environments, Gill and Kumar (1989), Hossain *et al.,* (2003), Popovic *et al.,* (2013), Lakew *et al.,* (2014), Hamawaki *et al.,* (2015) and Silva *et al.,* (2016).

If we dealt strictly to the results obtained in table (15), we find that all soybean germplasms used in this study gave highly a genetic stability with unrivaled form for all traits calculated of the twelve environments under studding during three locations, two years and two dates of sowing and the best data of all traits studied for the previous seven soybean genotypes were exhibited from the experiments; (L1 PD1 Y1), (L1 PD1 Y2), (L2 PD1 Y1), (L2 PD1 Y2), (L3 PD1 Y1), (L3 PD2 Y1) and (L3 PD1 Y2), respectively.

This consistency will help us to use it as an asset genetic fixed under various environments conditions in soybean breeding programs to increase yielding, quality traits, resistance for diseases, adverse environmental conditions through crossing it with sensitive and moderate entries for the environmental stresses such as, salinity and water stress, then the simple selection method will be the second stage among continuing for several generations of agriculture evaluation for accessing to genetic stability and this trend in the genetic improvement will not be unless the parents were highly genetic stability as we explained previously, So we can say that the previous genotypes characterized with highly genetic stability under all conditions of the twelve environments specially the cultivars; (Crawford, Giza 21, Giza 22, Giza 35, Giza 83, Giza 111) for 1000-grain weight, number of grains/plant, grain weight/plant and grain yield/plant traits in figure (1) and (A, B, C, D histograms), respectively. Similar results were in agreement with those reported by Gill and Kumar (1989), Hossain *et al.,* (2003), Popovic *et al.,* (2013), Lakew *et al.,* (2014), Hamawaki *et al.,* (2015) and Silva *et al.,* (2016).

Stability Parameters

The results in table (16), revealed that the optimum values of bi (Regression coefficient) were observed in the entries;(Crawford, Giza 22, Giza 35, Giza 83) for plant height, (Giza 21, Giza 35, Giza 83) for first pod height, (Giza 21, Giza 22, Giza 83, Giza 111) for number of pods/plant, (Crawford, Giza 21, Giza 22) for 1000-grain weight, (Crawford, Giza 21, Giza 22, Giza 35, Giza 111) for number of grains/plant, (Crawford, Giza 21, Giza 82) for grain weight/plant and (Giza 21, Giza 82, Giza 83, Giza 111) for grain yield/plant traits because these genotypes equated to the unit or nearing from it, which confirmed the severity, highly genetic stability and the extent of their adaptability for different environments and conditions, while higher values than one were observed in the two directions for the other traits of the other genotypes indicates decreasing of

genetic stability and the range of adapting for these cultivars under different conditions in addition, this various will be change from entry to entry according to the type of this environment, respectively.

For S^2di parameter, the best genotypes recorded the values (0.0) or nearing from it for all traits studied under all environments were showed in the soybean entries (Crawford, Giza 35, Giza 82) for plant height, (Giza 22, Giza 35, Giza 83, Giza 111) for first pod height, (Crawford, Giza 22) for number of pods/plant, (Giza 111) for 1000-grain weight, (Crawford) for number of grains/plant, (Giza 35, Giza 83, Giza 111) for grain weight/plant and (Crawford, Giza 22, Giza 35, Giza 82, Giza 83, Giza 111) for grain yield/plant traits which confirmed the highest genetic stability of these cultivars under any conditions, all experiments and underscoring the extent and the possibility of using itas a genetic fixed assets in breeding programs for improving the agronomic traits, resistance for diseases and environmental adversity with good agricultural management, while the other genotypes for the same traits were very bad and not fruitfully because they were moved away from the value (0.0) and will not be suitable for all conditions.

With respect to the percentages of stability (R^2), the genotypes; (Giza 21, Giza 22, Giza 111) for plant height, (Crawford, Giza 22, Giza 35) for first pod height, (Crawford, Giza 21) for number of pods/plant, (Crawford, Giza 35, Giza 83) for 1000-grain weight, (Giza 21, Giza 82, Giza 83) for number of grains/plant, (Crawford, Giza 83) for grain weight /plant and grain yield/plant traits in addition to (Giza 111) only for grain yield/plant were revealed the highest percentages of stability and the values ranged from (78.90 % to 99.40 %) which indicates that these genotypes were suitable for all environments with good agricultural management. This stability reflects the extent of genetic and environmental acclimatization enjoyed these soybean entries.

The results in table (17) confirmed that the environments(L1 PD1 Y2), (L2 PD1 Y2), (L2 PD2 Y2) and (L3 PD1 Y1)through using the three stability parameters (bi, S^2di, R^2) were exhibited the optimum values for all traits studied where the values equaled the unity for (bi), equaled (0.0) for (S^2di) and the percentages of (R^2) were neared from 100 % which indicated the highest genetic stability of the seven soybean entries for all traits studied under these environments and confirmed also the planting of it will be suitable for any environment with good administration for improving soybean entries through crossing these the previous cultivars with the rest lines which needing to transfer all traits responsible for high yielding, tolerance for salinity, water stress and resistance for diseases from the fixed genotypes, then simple selection for all obtained hybrids (F1 Generation) to choose the best of them according to the previous criteria, then continuous in this work for several generations to reach to fixed lines including the previous criteria beside the genetic stability and adapting for any environment. On the other hand the rest of environments were revealed low genetic stability in their interaction using the previous soybean entries.

Accordingly, we note that the genotypes; (Crawford, Giza 21, Giza 22, Giza 35, Giza 83, Giza 111) were the most genetic stability entries and recommended for using it under different environments, while the cultivar (Giza 82) coming in the second rank, Gill and Kumar (1989), Mohan and Har Ram (2006), Vera *et al.,* (2013), Popovic *et al.,* (2013), Dewi *et al.,* (2014), Lemes *et al.,* (2015), Lodhi *et al.,* (2015), Hamawaki *et al.,* (2015), Gunjan *et al.,* (2016), Silva *et al.,* (2016) and Tiwari *et al.,* (2016).

Genetic components

The calculated values of genotypic, phenotypic and error variance, heritability in broad sense, genotypic (G.C.V) and phenotypic (P.C.V) coefficients of variation are detected in Table (18).

With respect to plant height, 1000-grain weight, number of grains/plant and grain yield/plant traits studied, the genotypic and phenotypic variance calculated were observed large, in comparison with the obtained values of error variance, such a result seemed to mean that the number of blocks used in the experiments of these entries for these traits were adequate to give a better estimation for the error variance, while the values of error variance estimated for the rest traits were appeared central between genotypic and phenotypic variance, which indicated that the number of replicates used in these experiments for (First pod height, number of pods/plant, grain weight/plant traits) of the previous genotypes were adequate to give highest estimation for the error variance with partially form.

The percentages of heritability in broad sense were seemed to be moderately in first pod height, 1000-grain weight, number of grains/plant and grain weight/plant traits where the values were (56.71 %, 67.61 %, 52.43 %, 61.11 %), respectively, which confirmed that the effect of genotypic variance was higher than the environmental variance with moderately form but theenvironmental impact cannot be neglected because it impact on these traits approached from (32.39% to47.57%), while the rest of traits studied (plant height, number of pods/plant and grain yield/plant)were revealed the highest percentages of heritability in broad sense and the values were (78.86 %, 85.98 %, 88.55 %), which indicated that the major part of variance was genotypic variance, but the environmental variance was very low and it impact on these traits was almost non-existent, this is reflected highly genetic stability of these varieties through estimating of these traits under studding, respectively.

The assessments of genotypic (G.C.V) and phenotypic (P.C.V) coefficients of variation revealed low percentages of differences among them for all traits calculated, detecting that environmental effects were not impressive on these traits. These results were assured by heritability values, Gill and Kumar (1989), Popovic *et al.,* (2013), Hamawaki *et al.,* (2015) and Silva *et al.,* (2016).

Molecular markers

Resulted obtained from the data analysis of the four RAPD primers for the seven soybean entries were presented in table (19) and figure (2).12 fragments were generated through using the previous four primers, where 4 of them were monomorphic bands with 33.33%, while 8 fragments were polymorphic with 66.67% polymorphism and the four primers revealed average 3 bands/primer, respectively.

From the previous results we can observed that the first primer (OPC10) detected two polymorphic fragments only and recorded the highest percentage of polymorphism with100% through comparing among the seven soybean entries and ranged from 100 to 300 bp, while that the second and third primers (OPF-4, OPA-17) were revealed the same results, where recorded three amplicons for each primer, two of them were polymorphic with 66.67% polymorphism, one fragment only was monomorphic and the range size of bands ranged from 100 to 400 bp and 100 to 500 bp, respectively.
On the same track, the last primer (OPG-5) recorded four fragments, two of them were monomorphic bands and two fragments were

polymorphic with 50% polymorphism and was the lowest percentage of polymorphism and ranged from 100 to 657 bp, respectively.

The results indicated that the highest number of fragments was showed in primer (OPG-5) where recorded four amplicons and the polymorphism was 50% followed by the primers (OPF-4, OPA-17) where revealed three fragments and 66.66% polymorphism for each primer, while the lowest number of amplicons was generated from the primer (OPC-10) where detected two fragments only with highly percentage of polymorphism (100%), respectively.

Similar results were obtained by Tinker *et al.,* (1993), Fernandez *et al.,* (2002), Milad *et al.,* (2011), Huseynova *et al.,* (2015), Heiba *et al.,* (2016 a), Heiba *et al.,* (2016 b), El-Mouhamady *et al.,* (2016), Ramadan *et al.,*(2016) and Khatab *et al.,*(2017).

Determined the genetic relationships among the seven soybean germplasms were showed in terms of similarity using Dice coefficient, these results revealed within the date presented in Fig (3) and Table (20). RAPD-PCR markers used to figure out the soybean entries relationships by UPGMA of the dendrogram and in the Proximity matrix recognized relationships among the promising seven soybean cultivars.

The genetic similarity values ranged from (0.615 to 1.00) with mean value (0.807) containing 21 pair wise comparisons among the seven genotypes of soybean based on 12 amplicons using four primers dividing into 8 fragments polymorphic with 66.67% polymorphism and 4 monomorphic bands, where the lowest similarity was (0.615) among genotypes (2, 7), while the highest values was (1.00) between genotypes (1, 3) and (5, 6), while that the middle values of similarity were observed between the genotypes (1, 4) and (3, 4) with value of (0.875) for each one and among the genotypes (1, 5), (1, 6), (3, 5) and (3, 6) with value of (0.90) for each group, respectively.

The soybean cultivars number (1, 3, 5, 6) achieved the biggest proof of high genetic stability and relationship (phylogenetic) among them and this stability responsible for highly production and resistance for diseases and stresses under different locations, conditions and environments, So using of these germplasms in soybean breeding programs on widely will be fruitfully and more effective under Egyptian conditions.

Genetic similarity

The phylogenetic tree of cluster analysis in figure 3 divided into two main groups, the first one divided into one sub-group and contained the genotypes number (2, 4), while the second main group divided into two sub-group, the first one involved the genotype number (7), while that the second sub-group divided into two classes, where the first class included the genotypes number (1, 3), while the second class comprised the genotypes number (5, 6), similar results were reported by Ramadan *et al.,*(2016) and Khatab *et al.,* (2017).

From the previous results it could be concluded that the phylogenetic tree demonstrated that the soybean cultivars (1, 3, 5, 6) were recorded highly genetic stability and relationship and this investigation asserted that the data secured from all traits studied under different locations, conditions and environmentswere pretty much identical.

Table.1 Classification of the Seven Soybean Cultivars

NO.	Name of Cultivars	Types of Elicitation	Resistance for Diseases	Origin	Duration of Maturity
G1	Crawford	All Tradition Methods of breeding	Resistance	Egypt	120 day
G2	Giza 21	By Hybridization	Resistance	Egypt	125-130 day
G3	Giza 22	By Hybridization	Moderately	Egypt	115 day
G4	Giza 35	By Hybridization	Resistance	Egypt	105-110 day
G5	Giza 82	By Hybridization	Resistance	Egypt	95-100 day
G6	Giza 83	By Hybridization	Resistance	Egypt	95-100 day
G7	Giza 111	By Hybridization	Resistance	Egypt	125 day

G: - Genotype

Table.2 Chemical analysis of soil for the three locations through the two seasons (2015, 2016) for the two planting dates of soybean

Characteristics of Soil	Location (1)				Location (2)				Location (3)			
	Season(1)		Season(2)		Season(1)		Season(2)		Season(1)		Season(2)	
	PD1	PD2	PD1	PD2	PD1	PD2	PD1	PD2	PD1	PD2	PD1	PD2
EC (dS/m)	1.86	1.70	1.82	1.80	1.79	1.75	1.85	1.83	1.69	1.74	1.77	1.72
pH (1:2.5)	7.0	7.22	7.11	7.33	7.18	7.25	7.34	7.23	7.15	7.06	7.40	7.23
TDS mg/litre (ppm)	722.0	725.0	810.0	765.0	730.0	734.0	800.0	750.0	735.0	816.0	750.0	756.0
Ca++	4.0	4.33	5.0	5.18	4.73	4.60	5.0	5.07	4.55	4.78	5.16	4.77
Mg++	2.77	2.80	3.12	2.96	2.80	2.82	2.86	2.85	2.79	3.06	3.0	2.89
Na+	11.35	11.17	12.0	11.50	13.67	12.85	11.18	10.78	11.0	9.34	10.55	10.14
K+	0.66	0.69	0.48	0.44	0.64	0.55	0.48	0.50	0.76	0.72	0.78	0.65
CO3 --	0.05	51	0.03	0.06	0.07	0.04	0.04	0.03	0.08	0.06	0.02	0.05
HCO3 -	5.0	4.66	3.66	4.08	3.23	3.50	6.45	5.67	4.78	5.11	3.29	5.06
Cl-	17.0	15.5	16.40	16.66	14.88	15.5	14.94	17.06	16.88	17.43	16.32	15.45
SO4 --	1.67	1.72	1.88	1.75	1.55	1.74	1.80	1.77	1.83	1.71	1.65	1.60

(1):-PD1 is means:- First Planting Date, (2):- PD2 is means:- Second Planting Date, EC = Electrical conductivity, TDS = Total dissolved salts, * Measure of soil saturation, ** Measure of soil water extract 1:5, Texture: clay.

Table.3 Classification of average temperature and relative humidity (%) for all locations during the two seasons (2015 and 2016)

Classification of weather	Location (1)				Location (2)				Location (3)			
	Season(1)		Season(2)		Season(1)		Season(2)		Season(1)		Season(2)	
Relative Humidity(%)	**PD1**	**PD2**	**PD1**	**PD2**	**PD1**	**PD2**	**PD1**	**PD2**	**PD1**	**PD2**	**PD1**	**PD2**
May	58.0	60.0	64.5	62.0	55.5	68.0	69.0	55.7	60.0	58.8	62.0	64.0
June	62.0	65.0	67.5	68.0	57.0	56.5	54.0	55.0	60.0	58.0	62.0	65.0
July	66.0	68.0	69.0	65.0	70.0	72.0	59.0	64.0	70.0	68.0	63.0	61.0
August	70.0	75.0	72.0	68.0	61.0	63.0	66.0	70.0	66.0	70.0	77.0	80.0
Mean	64.0	67.0	68.25	65.75	60.87	64.87	62.0	61.17	64.0	63.62	66.0	67.5
Average Temperature (ºC)	**PD1**	**PD2**	**PD1**	**PD2**	**PD1**	**PD2**	**PD1**	**PD2**	**PD1**	**PD2**	**PD1**	**PD2**
May	32.0	31.0	34.0	35.0	33.0	34.0	36.0	34.0	35.0	33.0	32.0	34.0
June	36.0	34.0	35.0	36.0	39.0	32.0	34.0	37.0	40.0	34.0	42.0	36.0
July	35.0	31.0	37.0	38.0	38.0	40.0	36.0	38.0	39.0	43.0	37.0	39.0
August	34.0	36.0	34.0	36.0	40.0	42.0	33.0	37.0	37.0	44.0	35.0	39.0
Mean	34.25	33.0	35.0	36.5	37.5	37.0	34.75	36.5	37.75	38.5	36.5	37.0

(1):-PD1 is means:- First Planting Date, (2):- PD2 is means:- Second Planting Date

Table.4 Sequences of the four RAPD primers

No.	Code name	5'-3' Sequences
RAPD		
1	OPC10	TGTCTGGGTG
2	OPF-4	GAATGCGGAG
3	OPA-17	GACCGCTTGT
4	OPG-05	CTGACGTCAC

Note:- Ten RAPD-PCR primers were used in this study, but the previous four primers were successed for comparing among the seven soybean entries

Table.5 Estimation of Mean Squares for all traits studied in soybean during Stability analysis

S.O.V	D.F	M.S						
		P.H	H.P.F	P/P.FO.ON	1000.G.W	NO.OF.G/P	G.W/P	G.Y/P
Environments	11	40.18**	2.89**	11.80**	0.88**	3.85**	0.59**	7.63**
Blocks in (E)	2	1.12	1.48	1.07	2.78	1.39	1.43	2.36
Genotypes	6	2.89**	4.02**	1.38**	6.23**	1.84**	0.75**	2.47**
Genotypes × Environments	66	5.56**	12.05**	1.29**	13.84**	2.63**	6.32**	11.34**
Error	144	0.73	0.33	1.26	2.18	1.58	0.88	0.04
Environments + (Genotypes × Environments)	77	0.96**	1.56**	11.70**	0.83**	1.32**	15.67**	11.25**
Environmental (linear)	1	1.87**	2.14**	2.78**	0.89**	1.34**	1.26**	0.77**
(Genotypes× Environments) Linear	6	11.67**	5.34**	3.62**	1.69**	13.45**	2.88**	6.44**
Pooled deviation	7	4.06**	7.11**	3.03**	5.18**	8.09**	2.89**	6.01**
Pooled error	168	0.94	0.45	2.46	3.39	2.20	1.14	0.02

P*≤ 0.05, P≤ 0.01**

Table.6 F-Ratio values for the components of Stability analysis

S.O.V	P.H	F.P.H	P/P.FO.ON	1000.G.W	NO.OF.G/P	G.W/P	G.Y/P
Environments	55.04	8.75	9.36	0.40	2.43	0.67	190.75
Blocks in (E)	1.53	4.48	0.85	1.27	0.88	1.62	59.0
Genotypes	3.96	12.18	1.09	2.85	1.16	0.85	61.75
Genotypes × Environments	7.62	36.51	1.02	6.34	1.66	7.18	283.5
Environment + (Genotype × environment)	1.02	3.46	4.75	0.24	0.60	13.74	562.50
Environmental (linear)	1.98	4.75	1.13	0.26	0.61	1.10	38.50
(Genotype× Environmental) Linear	12.41	11.86	1.47	0.49	6.11	2.52	322.0
Pooled deviation	4.32	15.80	1.23	1.52	3.67	2.53	300.50

Probability>F = <0.0001

Table.7 The mean values for the seven soybean Genotypes under the twelve environments for Plant height trait

All Conditions	Crawford	Giza 21	Giza 22	Giza 35	Giza 82	Giza 83	Giza 111	Mean
(L1 PD1 Y1)	74.80	74.0	73.0	68.7	75.0	69.50	65.5	71.5
(L1 PD2 Y1)	66.5	67.0	63.0	68.0	74.5	66.0	57.0	66.0
(L1 PD1 Y2)	71.5	75.0	72.0	70.7	76.5	72.5	76.3	73.5
(L1 PD2 Y2)	65.0	65.5	66.4	64.0	67.3	67.0	59.8	65.0
(L2 PD1 Y1)	72.4	72.10	72.5	72.3	75.0	72.5	70.0	72.4
(L2 PD2 Y1)	65.5	66.0	64.0	67.0	66.0	64.5	62.0	65.0
(L2 PD1 Y2)	74.0	75.0	73.5	76.0	76.0	72.5	71.0	74.0
(L2 PD2 Y2)	70.0	60.0	65.0	64.4	68.6	66.0	56.8	64.40
(L3 PD1 Y1)	73.0	74.0	72.0	71.5	78.0	70.5	72.0	73.0
(L3 PD2 Y1)	63.0	64.0	65.0	62.0	69.0	61.0	64.0	64.0
(L3 PD1 Y2)	72.5	73.0	75.5	77.0	77.0	71.0	72.0	74.0
(L3 PD2 Y2)	62.0	61.0	63.0	66.0	68.0	60.0	61.0	63.0
Mean	69.18	68.88	68.74	68.96	72.57	67.75	65.61	68.81

Table.8 The mean values for the seven soybean Genotypes under the twelve environments for First Pod height trait

All Conditions	Crawford	Giza 21	Giza 22	Giza 35	Giza 82	Giza 83	Giza 111	Mean
(L1 PD1 Y1)	28.0	26.5	25.45	29.0	27.0	28.0	25.05	27.0
(L1 PD2 Y1)	20.0	22.0	24.5	21.5	23.0	25.0	18.0	22.0
(L1 PD1 Y2)	30.0	32.0	28.0	26.0	24.0	31.0	25.0	28.0
(L1 PD2 Y2)	23.7	22.8	24.0	23.0	22.5	23.7	21.3	23.0
(L2 PD1 Y1)	31.5	30.0	25.5	28.0	27.0	27.5	26.5	28.0
(L2 PD2 Y1)	21.0	23.0	19.0	24.0	20.0	19.5	20.5	21.0
(L2 PD1 Y2)	27.0	29.5	30.5	26.5	28.5	29.0	32.0	29.0
(L2 PD2 Y2)	28.0	27.0	26.0	25.0	24.0	26.5	25.5	26.0
(L3 PD1 Y1)	30.5	28.7	29.0	27.5	26.0	32.0	29.30	29.0
(L3 PD2 Y1)	23.0	24.0	17.0	19.5	18.5	20.0	18.0	20.0
(L3 PD1 Y2)	31.5	32.0	28.4	27.35	29.5	30.7	30.55	30.0
(L3 PD2 Y2)	23.5	21.5	24.0	19.78	22.0	23.0	20.22	22.0
Mean	26.47	26.58	25.11	24.76	24.33	26.32	24.32	25.41

Table.9 The mean values for the seven soybean Genotypes under the twelve environments for Number of Pods/Plant trait

All Conditions	Crawford	Giza 21	Giza 22	Giza 35	Giza 82	Giza 83	Giza 111	Mean
(L1 PD1 Y1)	33.0	37.0	35.0	31.0	35.0	32.5	41.5	35.0
(L1 PD2 Y1)	27.0	30.0	31.0	28.0	26.5	32.0	30.6	29.3
(L1 PD1 Y2)	35.0	37.0	36.0	38.0	30.0	39.0	37.0	36.0
(L1 PD2 Y2)	30.0	31.5	28.5	27.0	28.0	29.0	29.14	29.02
(L2 PD1 Y1)	35.7	34.8	36.0	37.0	30.0	38.0	33.5	35.0
(L2 PD2 Y1)	33.0	30.0	29.0	28.5	21.0	31.0	37.5	30.0
(L2 PD1 Y2)	33.0	34.5	36.0	35.0	29.0	32.0	54.11	36.23
(L2 PD2 Y2)	25.8	32.0	28.5	27.0	24.5	31.0	39.10	29.7
(L3 PD1 Y1)	31.5	33.0	34.5	33.5	31.0	31.5	50.0	35.0
(L3 PD2 Y1)	31.5	32.0	28.5	27.5	27.0	29.0	37.3	30.4
(L3 PD1 Y2)	35.0	37.8	37.0	36.0	30.0	34.0	42.2	36.0
(L3 PD2 Y2)	28.0	29.0	35.0	28.5	26.5	29.6	33.4	30.0
Mean	31.54	33.21	32.91	31.41	28.20	32.38	38.77	32.63

Table.10 The mean values for the seven soybean Genotypes under the twelve environments for 1000-grain weight trait

All Conditions	Crawford	Giza 21	Giza 22	Giza 35	Giza 82	Giza 83	Giza 111	Mean
(L1 PD1 Y1)	213.0	205.0	204.5	202.7	192.0	210.0	228.8	208.0
(L1 PD2 Y1)	200.0	195.0	190.0	191.5	177.0	205.0	185.5	192.0
(L1 PD1 Y2)	207.0	204.0	202.0	208.5	196.0	205.8	239.7	209.0
(L1 PD2 Y2)	190.0	188.5	191.0	185.0	177.8	188.0	209.7	190.0
(L2 PD1 Y1)	207.0	210.0	212.0	208.6	200.0	213.0	219.82	210.06
(L2 PD2 Y1)	200.0	190.0	195.0	188.0	180.0	192.0	209.85	193.55
(L2 PD1 Y2)	204.0	202.0	205.5	203.0	200.0	206.0	223.81	206.33
(L2 PD2 Y2)	180.0	185.0	184.0	186.0	175.0	190.0	223.84	189.12
(L3 PD1 Y1)	210.4	212.5	208.0	207.0	195.0	213.0	239.36	212.18
(L3 PD2 Y1)	188.0	190.0	194.0	191.0	183.0	187.0	204	191.0
(L3 PD1 Y2)	202.0	197.0	200.0	210.0	188.0	201.0	230.0	204.0
(L3 PD2 Y2)	186.0	188.0	184.0	190.0	179.0	192.0	183.0	186.0
Mean	198.95	197.25	197.50	197.60	186.90	200.23	216.44	199.27

Table.11 The mean values for the seven soybean Genotypes under the twelve environments for Number of grains/plant trait

All Conditions	Crawford	Giza 21	Giza 22	Giza 35	Giza 82	Giza 83	Giza 111	Mean
(L1 PD1 Y1)	95.0	92.0	93.5	94.6	77.0	89.5	102.4	92.0
(L1 PD2 Y1)	80.0	84.5	82.5	81.0	78.0	84.0	98.0	84.0
(L1 PD1 Y2)	88.0	94.0	92.0	87.5	84.0	89.0	109.5	92.0
(L1 PD2 Y2)	85.0	90.0	88.0	79.0	75.0	80.0	77.0	82.0
(L2 PD1 Y1)	89.5	88.5	87.0	90.0	81.0	84.0	110.0	90.0
(L2 PD2 Y1)	78.0	80.0	79.0	81.0	72.0	76.0	94.0	80.0
(L2 PD1 Y2)	90.0	92.0	88.0	89.5	83.0	91.0	117.5	93.0
(L2 PD2 Y2)	77.0	78.5	80.0	80.4	74.0	80.7	101.3	81.7
(L3 PD1 Y1)	88.0	87.0	90.0	84.0	80.0	88.3	112.98	90.04
(L3 PD2 Y1)	80.0	77.8	78.0	83.0	73.5	81.0	93.7	81.0
(L3 PD1 Y2)	91.0	88.0	86.0	90.0	80.0	93.0	130.0	94.0
(L3 PD2 Y2)	77.8	76.5	75.0	77.0	70.5	79.8	96.4	79.0
Mean	84.94	85.73	84.91	84.75	77.33	84.69	103.56	86.56

Table.12 The mean values for the seven soybean Genotypes under the twelve environments for Grain weight/Plant trait

All Conditions	Crawford	Giza 21	Giza 22	Giza 35	Giza 82	Giza 83	Giza 111	Mean
(L1 PD1 Y1)	14.0	13.5	12.0	11.5	10.0	13.0	20.5	13.50
(L1 PD2 Y1)	11.0	9.5	8.5	9.0	7.0	10.0	15.0	10.0
(L1 PD1 Y2)	17.0	14.0	13.5	12.5	10.5	13.7	20.72	14.56
(L1 PD2 Y2)	10.0	9.5	9.8	11.0	8.70	9.0	15.22	10.46
(L2 PD1 Y1)	13.0	12.7	14.0	14.5	11.0	13.5	22.38	14.44
(L2 PD2 Y1)	13.0	11.5	13.0	12.0	8.7	11.0	11.86	11.58
(L2 PD1 Y2)	13.5	12.7	14.0	15.0	10.0	13.0	19.8	14.0
(L2 PD2 Y2)	12.5	10.5	11.5	10.8	7.5	11.0	13.2	11.0
(L3 PD1 Y1)	14.5	13.7	12.5	12.8	10.0	14.0	20.5	14.0
(L3 PD2 Y1)	12.0	11.6	12.4	9.5	8.5	9.0	14.0	11.0
(L3 PD1 Y2)	18.0	16.5	14.5	13.5	11.5	18.5	19.5	16.0
(L3 PD2 Y2)	14.0	13.0	12.8	12.5	10.0	14.0	14.7	13.0
Mean	13.54	12.39	12.37	12.05	9.45	12.47	17.28	12.79

Table.13 The mean values for the seven soybean Genotypes under the twelve environments for Grain yield/plant trait

All Conditions	Crawford	Giza 21	Giza 22	Giza 35	Giza 82	Giza 83	Giza 111	Mean
(L1 PD1 Y1)	3.0	3.2	2.9	2.7	2.5	3.1	5.28	3.24
(L1 PD2 Y1)	2.5	1.5	1.7	1.8	1.34	1.6	3.56	2.0
(L1 PD1 Y2)	3.0	2.9	2.9	2.8	2.6	2.7	4.1	3.0
(L1 PD2 Y2)	2.0	1.98	1.9	1.95	1.88	2.05	3.01	2.11
(L2 PD1 Y1)	3.0	2.88	2.9	2.89	2.5	3.03	4.15	3.05
(L2 PD2 Y1)	2.2	2.3	2.05	2.0	1.7	2.1	4.45	2.4
(L2 PD1 Y2)	3.0	3.12	3.07	2.88	2.44	2.98	4.35	3.12
(L2 PD2 Y2)	2.08	2.11	2.05	2.04	2.0	2.07	3.19	2.22
(L3 PD1 Y1)	3.2	3.0	2.9	3.1	2.76	3.05	4.81	3.26
(L3 PD2 Y1)	3.5	3.0	3.3	2.9	2.4	2.8	3.1	3.0
(L3 PD1 Y2)	3.2	3.0	2.9	3.08	2.8	3.5	4.2	3.24
(L3 PD2 Y2)	2.5	2.3	1.8	2.0	1.4	1.7	2.3	2.0
Mean	2.76	2.60	2.53	2.51	2.19	2.55	3.87	2.72

Table.14 The mean values obtainedof the seven soybean Genotypes under all environments forall traits studied

Genotypes	P.H	F.P.H	NO.OF.P/P	1000.G.W	NO.OF.G/P	G.W/P	G.Y/P
Crawford	69.18	26.47	31.54	198.95	84.94	13.54	2.76
Giza 21	68.88	26.58	33.21	197.25	85.73	12.39	2.60
Giza 22	68.74	25.11	32.91	197.50	84.91	12.37	2.53
Giza 35	68.96	24.76	31.41	197.60	84.75	12.05	2.51
Giza 82	72.57	24.33	28.20	186.90	77.33	9.45	2.19
Giza 83	67.75	26.32	32.38	200.23	84.69	12.47	2.55
Giza 111	65.61	24.32	38.77	216.44	103.56	17.28	3.87

Table.15 The mean values for each trait of each experiment for all soybean entries

All Conditions	P.H	F.P.H	NO.OF.P/P	1000.G.W	NO.OF.G/P	G.W/P	G.Y/P
(L1 PD1 Y1)	71.5	27.0	35.0	208.0	92.0	13.50	3.24
(L1 PD2 Y1)	66.0	22.0	29.3	192.0	84.0	10.0	2.0
(L1 PD1 Y2)	73.5	28.0	36.0	209.0	92.0	14.56	3.0
(L1 PD2 Y2)	65.0	23.0	29.02	190.0	82.0	10.46	2.11
(L2 PD1 Y1)	72.4	28.0	35.0	210.06	90.0	14.44	3.05
(L2 PD2 Y1)	65.0	21.0	30.0	193.55	80.0	11.58	2.40
(L2 PD1 Y2)	74.0	29.0	36.23	206.33	93.0	14.0	3.12
(L2 PD2 Y2)	64.4	26.0	29.7	189.12	81.70	11.0	2.22
(L3 PD1 Y1)	73.0	29.0	35.0	212.18	90.04	14.0	3.26
(L3 PD2 Y1)	64.0	20.0	30.4	191.0	81.0	11.0	3.0
(L3 PD1 Y2)	74.0	30.0	36.0	204.0	94.0	16.0	3.24
(L3 PD2 Y2)	63.0	22.0	30.0	186.0	79.0	13.0	2.0
Mean	68.81	25.41	32.63	199.27	86.56	12.79	2.72

L: Location, Y: Year,PD1: First planting date,PD2: Second planting date

Table.16 Estimation of Stability Parameters for all Traits Studies for the Seven Soybean Entries

Traits	P.H			F.P.H			NO.OF.P/P			1000.G.W			NO.OF.G/P			G.W/P			G.Y/P		
Entries	**bi**	**S^2di**	**R^2**	**bi**	**S^2di**	**R^2**	**bi**	**S^2di**	**R^2**	**bi**	**S^2di**	**R^2**	**bi**	**S^2di**	**R^2**	**bi**	**S^2di**	**R^2**	**bi**	**S^2di**	**R^2**
Crawford	1.04	-0.6	87.10	1.28	1.6	95.60	1.33	-0.6	80.80	0.84	-1.8	93.00	1.10	0.6	78.10	0.95	-0.8	78.90	1.25	0.00	90.70
Giza 21	1.20	-0.7	97.50	0.90	0.9	92.60	0.91	-1.8	80.00	0.80	1.7	92.70	0.98	1.0	92.60	0.99	-1.0	59.60	0.93	-0.02	79.30
Giza 22	1.07	-0.8	97.10	1.09	-0.2	94.80	1.06	-0.8	56.40	1.03	3.7	91.60	0.93	-1.5	88.00	0.93	-0.9	57.20	0.73	-0.01	67.10
Giza 35	1.00	0.0	96.50	1.08	-0.2	94.40	0.76	-2.0	50.90	1.72	8.2	99.40	1.14	-1.2	89.20	0.93	-0.5	66.90	0.81	-0.01	44.10
Giza 82	0.78	-0.3	69.50	0.84	0.7	85.90	1.13	-1.9	76.90	0.71	4.2	90.40	0.94	-1.7	90.30	1.06	-0.9	67.00	1.13	-0.01	79.90
Giza 83	1.06	-0.6	96.70	0.98	-0.3	93.60	0.90	-1.3	74.20	1.26	-2.5	95.90	0.92	-1.4	91.70	0.94	-0.5	75.10	1.10	0.00	96.30
Giza 111	1.35	-0.6	96.90	0.83	-0.3	62.60	0.91	-1.3	73.60	0.64	-0.7	68.60	0.97	-1.7	76.50	1.21	-0.7	68.20	1.04	0.01	85.20

Table.17 Estimation of Stability Parameters for all Traits Studies for the Seven Soybean Entries under all Environments

Traits	P.H			F.P.H			NO.OF.P/P			1000.G.W			NO.OF.G/P			G.W/P			G.Y/P		
Environments	**bi**	**S^2di**	**R^2**	**bi**	**S^2di**	**R^2**	**bi**	**S^2di**	**R^2**	**bi**	**S^2di**	**R^2**	**bi**	**S^2di**	**R^2**	**bi**	**S^2di**	**R^2**	**bi**	**S^2di**	**R^2**
(L1 PD1 Y1)	1.06	1.2	99.47	1.06	0.3	92.02	1.05	-0.9	95.35	1.15	1.8	98.53	1.03	-0.8	97.74	1.16	-0.4	83.31	1.09	-0.01	90.37
(L1 PD2 Y1)	0.98	2.1	96.77	1.05	0.1	91.58	0.98	0.8	92.11	0.86	0.9	85.87	1.09	0.5	95.55	1.09	-0.2	76.22	1.35	-0.01	60.47
(L1 PD1 Y2)	1.0	0.0	99.06	1.06	0.0	99.75	1.03	0.0	99.28	1.20	0.0	98.36	1.00	0.0	99.63	1.17	0.0	98.57	1.34	0.0	99.27
(L1 PD2 Y2)	0.97	1.3	97.23	1.05	0.1	91.58	0.93	1.6	85.76	0.91	0.8	88.55	0.99	-1.1	90.46	1.09	0.5	76.15	1.32	-0.01	67.15
(L2 PD1 Y1)	1.06	1.5	99.33	1.06	0.3	91.75	1.11	-1.6	94.41	1.10	0.9	98.15	1.09	-0.8	94.34	1.00	-0.4	71.75	1.04	-0.01	61.60
(L2 PD2 Y1)	0.98	2.0	96.63	1.04	0.1	92.18	1.11	-0.9	89.40	0.94	1.5	92.99	0.88	4.9	90.77	0.89	-0.4	66.39	1.35	0.01	59.07
(L2 PD1 Y2)	1.0	0.0	99.03	1.00	0.0	99.87	1.09	0.0	99.24	1.10	0.0	99.88	0.95	0.0	99.78	1.07	0.0	98.09	0.81	0.0	99.63
(L2 PD2 Y2)	1.0	0.0	99.71	1.0	0.0	98.09	1.0	0.0	99.59	1.0	0.0	99.08	1.00	0.0	99.17	1.0	0.0	99.49	1.0	0.0	99.63
(L3 PD1 Y1)	1.0	0.0	99.88	1.0	0.0	99.94	1.0	0.0	99.63	1.0	0.0	99.73	1.0	0.0	99.07	1.0	0.0	99.42	1.0	0.0	98.08
(L3 PD2 Y1)	0.94	2.2	97.15	0.97	0.7	91.94	0.91	-0.5	85.50	0.88	4.4	95.44	0.95	3.0	89.79	0.96	-0.4	47.0	0.45	0.00	33.75
(L3 PD1 Y2)	0.94	3.8	95.42	1.07	0.5	91.94	0.94	-0.5	99.30	1.08	.6	95.32	0.95	-0.8	94.31	0.93	0.0	49.64	0.81	0.01	43.95
(L3 PD2 Y2)	1.00	3.3	96.51	0.82	1.7	87.41	0.90	-0.5	98.26	0.87	1.3	88.51	1.00	-0.4	89.85	0.91	0.6	52.90	0.32	0.01	32.71

bi =Regression coefficient, S^2di=Deviation from regression, R^2: The percentage of stability P*≤0.05, p≤0**

Table.18 Genotypic (δ2 g), Phenotypic (δ2ph), error variances (δ2e), Heritability (H%) in the broad sense, Genotypic(G.C.V) and Phenotypic(P.C.V) coefficients of variation Estimates for Seven traits in Soybean Entries

Traits	Mean	Genotypic variation(δ^2g)	Phenotypic variation(δ^2ph)	Error variation(δ^2e) (Pooled Error)	Heritability (H %)	(G.C.V) %	(P.C.V) %
P.H	68.81	2.50	3.17	0.94	78.86	19.06	21.46
F.P.H	25.41	0.38	0.67	0.45	56.71	12.23	16.24
No. of. P/P	32.64	1.84	2.14	2.46	85.98	23.74	25.61
1000-G.W	199.27	4.76	7.04	3.39	67.61	15.46	18.79
No. of.G/P	86.56	3.66	6.98	2.20	52.43	20.56	28.39
G.W/P	12.79	0.77	1.26	1.14	61.11	24.54	31.39
G.Y/P	2.72	1.78	2.01	0.02	88.55	80.89	85.96

Table.19 Total number, Monomorphic, Polymorphic of Bands and Percentage of Polymorphism as Revealed by fourRAPD-PCR primerson Seven Genotypes of soybean

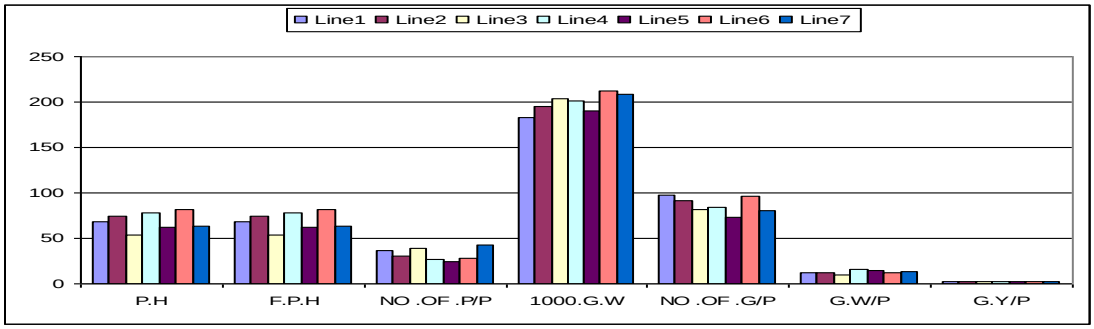
Primer Code	Loci	Polymorphic bands	Monomorphic bands	Polymorphism%	Range size of bands (bp)
OPC10	**2**	**2**	**0**	**100**	**100:300**
OPF-4	**3**	**2**	**1**	**66.67**	**100:400**
OPA-17	**3**	**2**	**1**	**66.67**	**100:500**
OPG-05	**4**	**2**	**2**	**50**	**100:657**
Total loci	**12(100%)**	**8(66.67%)**	**4 (33.33%)**	**70.83**	**100:464.25**

Table.20 Genetic similarity percentages of the seven cultivars of soybean based on four RAPD-PCR banding patterns

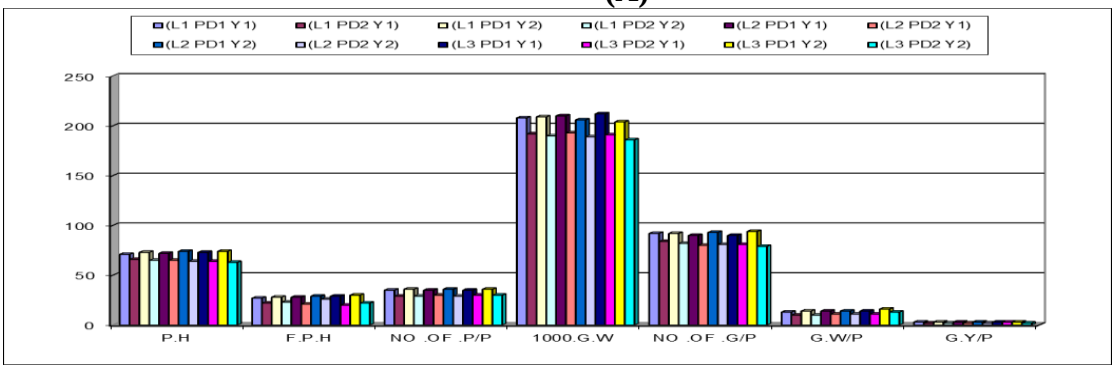
Similarity Matrix	G1	G2	G3	G4	G5	G6	G7
G1	**1.0**						
G2	**0.714**	**1.0**					
G3	**1.0**	**0.714**	**1.0**				
G4	**0.875**	**0.833**	**0.875**	**1.0**			
G5	**0.90**	**0.625**	**0.90**	**0.778**	**1.0**		
G6	**0.90**	**0.625**	**0.90**	**0.778**	**1.0**	**1.0**	
G7	**0.706**	**0.615**	**0.706**	**0.667**	**0.842**	**0.842**	**1.0**

G:- Genotype

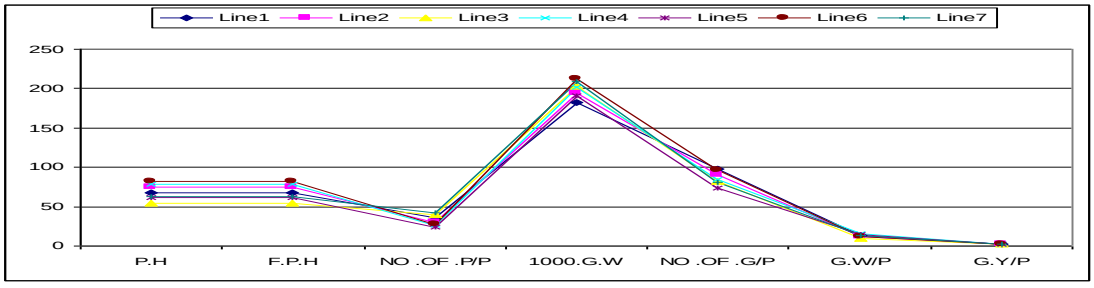
Fig.1 The stability analysis forms (A, B, C, D) for the seven traits studied of all soybean lines under all environments studied



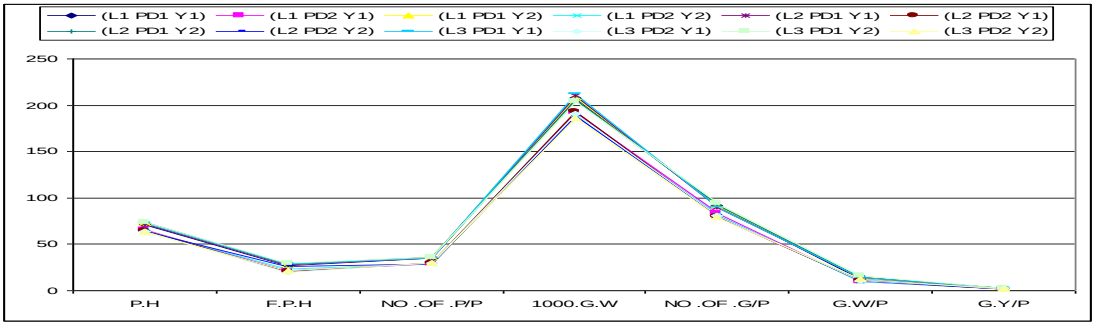
(A)



(B)



(C)



(D)

Fig.2 PCR fragments with using four RAPD primers of Seven Soybean Entries (1:7), M; DNA ladder (100bp) as markers

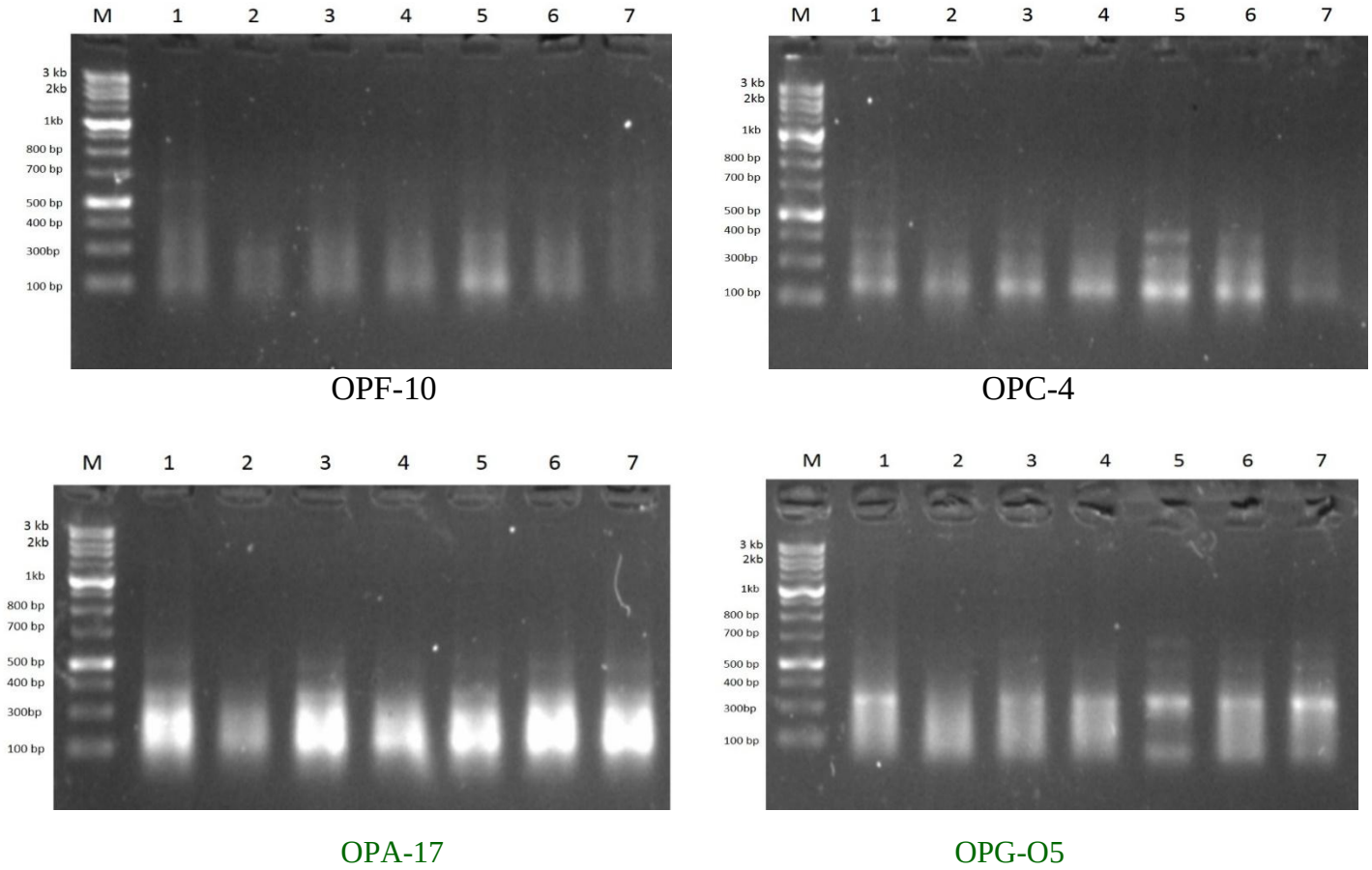
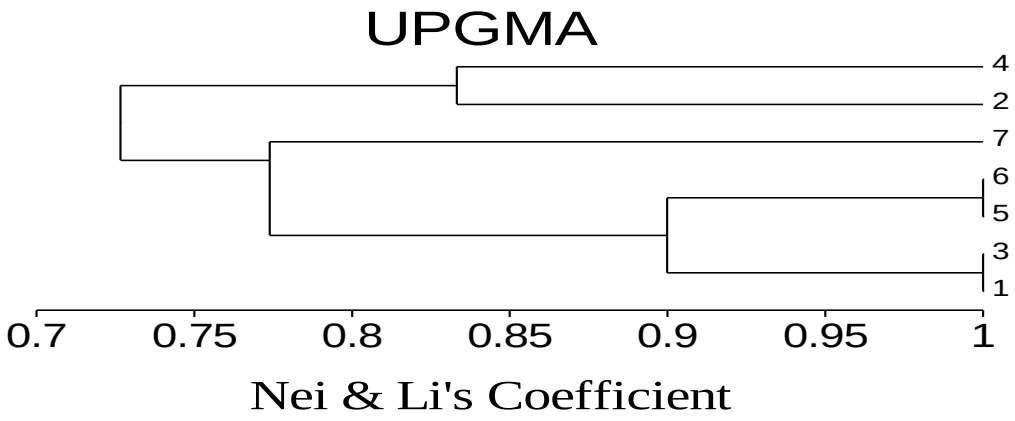


Fig.3 Dendrogram representing the genetic relationship among the seven soybean germplasms using UPGMA cluster analysis of Nei-Li's similarity coefficient generated from four RAPD-PCR markers



1:G1, 2: G2, 3: G3, 4: G4, 5: G5, 6: G6, 7: G7

Seven soybean entries were grown under twelve environments through three locations, two planting dates and two seasons to estimate the genetic stability on yield and its components traits. All parameters obtained from stability analysis were measurements under all conditions and environments beside genetic components for all traits studied. DNA fingerprinting analysis were determined using four primers namely;(OPC10, OPF-4, OPA-17, and OPG-5) to compare between the seven soybean cultivars and the results revealed that the previous four primers detected 12 fragments, where 8 of them were polymorphic with 66.67% polymorphism, while the other four amplicons were monomorphic. The phylogenetic tree divided the seven soybean genotypes into two main groups, the first one contained the genotypes (2, 4), while the second group involved the rest of genotypes. The final results confirmed that the genotypes; (Crawford, Giza 21, Giza 22, Giza 35, Giza 83, Giza 111) recorded highly yield, relationship and genetic stability under all environments and were suitable for any conditions.

Abbreviations:- P.H:- Plant height, F.P.H:- First pod height, NO.OF.P/P:- Number of pods/plant, 1000-G.W:- 1000-grain weight, NO.OF.G/P:- Number of grains/plant, G.W/P:- Grain weight/plant, G.Y/P;- Grain yield/plant, L:- Location, Y:- Year, PD1:- First planting date, PD2:- Second planting date, bi =Regression coefficient, S^2di=Deviation from regression, R^2: The percentage of stability.

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How to cite this article:

El-Mouhamady, A.A., H.M. Abdel-Rahman, T.A. Elewa and Aboud, K.A. 2017. Molecular Characterization and Stability Analysis for Yield and its Components Traits in Soybean (*Glycine Max* L.). *Int.J.Curr.Microbiol.App.Sci.* 6(7): 1835-1857.
doi: https://doi.org/10.20546/ijcmas.2017.607.221