Stability of Seed Yield and Seed Quality of Some Soybean Genotypes under Different Planting Dates

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ABSTRACT

A two-year field experiment was conducted at Sakha Agricultural Research Station, Kafr El-Sheikh, Egypt in 2013 and 2014 to study the effect of four planting dates (May 3, May 14, May 24, and June 4) on seed yield and seed quality of eighteen soybean genotypes, including eight cultivars(Giza21, Giza22, Giza35, Giza82, Giza83, Giza111, Clark and Crawford), eight promising lines (H_2L_{12}, H_2L_{20}, H_1L_{10}, L105, L153, L155, H117 and DR101) and two exotic varieties (Toano and Holladay). The results showed highly significant mean squares for soybean genotypes, environments and (G x E) interaction, indicating that the tested genotypes differed in their response to environmental conditions, and G12, G1, G9 and G16 (L105, Giza 21, H_2 L_{12}, and Toano), being the most stable ones. Also, delayed planting date from May 3 to June 4 significantly decreased number of days to flowering and maturity (40.46 and 142.09 days, to 30.80 and 117.67 days), respectively, shortened the reproductive growth stage from 102.10 to 86.88 days, decreased plant height from 95.05 to 84.14 cm and number of pods/plant from 103.62 to 78.95, along with reducing of 100-seeds weight from 17.91 to 15.44 g, and seed yield from 1790.90 to 1185.25 kg per feddan. On contrary, seed protein content and seed germination were increased from 34.80 and 70.25 (%) to 39.06 and 91.93 (%), respectively, while oil content and electrical conductivity were decreased by delaying planting from 23.14 to 19.58 (%) and 59.10 to (29.66) µ-mhos, respectively. The soybean genotypes varied in all studied traits, where DR 101 was the latest in flowering and maturity (48.42 and 155.79 days, respectively), Giza21, Giza111, L105 and L153 were the highest in 100-seed weight (18.49, 19.17, 18.73 and 18.07 g), respectively. Giza 82 and Giza 83 were the earliest in maturity (126.47 and 126.79 days) and the lowest in 100-seed weight (14.45 g). Giza 111 cultivar and L105 line produced the highest seed yields (1946.38 and 1898.17 kg/fed.). Giza 111cultivar, L105 and L153 lines produced the highest number of pods per plant (133.91, 126.46 and 126.92), while L155 and L153 lines produced the tallest plants (132.42 and 134.06 cm). Data showed also that DR101 was the best in seed germination over all planting dates with an average of 89.96(%), while, Clark recorded the lowest electrical conductivity (32.72 µ-mhos), Toano variety produced the highest oil % content (22.02%) and L153 line and DR101 produced the highest protein contents (38.61 and 38.43 %).

It could be concluded that Giza82, Clark, L105, H117, Toano and DR 101 could produce acceptable seeds with more than 80(%) seed germination when planted in early June, while the earlier genotypes Giza21, Giza22, Giza83, Giza111, Crawford, Clark, H2L12, L155 and Holladay have to be planted starting from early May to produce high yields with high quality and seed viability.

Key words: stability, planting dates, soybean genotypes, germination, seed vigor, and yield components

INTRODUCTION

Soybean (*Glycine max* L. Merrill) crop supplies more than 61(%) of the global demand of vegetable oil (USDA, 2017); seed is a major source of protein, oil, carbohydrates, isoflavones, and minerals for human and animal nutrition. About one-third of the world's edible oils and two-thirds of protein meal are derived from soybean seed. Thus, improving soybean seed composition and quality is the key to improve human and animal nutrition. Soybean crop is becoming popular in Egypt, and can produce acceptable yields through long period of time extending from mid-April to mid-June depending on the time of cleaning the field from the preceding crop (El-Borai *et al*., 2006). The use of genotype main effect (G) and genotype-by-environment (GE) interaction (G+GE) biplot analysis by plant breeders and other agricultural researchers has increased dramatically during this period for analyzing multi-environment yield trials (Yan *et al*., 2007). Also, they found that, GGE biplot is superior to the AMMI graph in mega-environment analysis and genotype evaluation because it explains more G+GE and has the inner-product property of the biplot. Plant breeders and geneticists, as well as statisticians, have a long-standing interest in investigating and integrating G and GE in selecting superior genotypes in variety yield trials (Yan *et al*., 2000).

Soybean seed quality refers to germination, and seedling vigor directly impacts the yield. Seed composition and quality are genetically controlled, and significant variation in seed quality and composition exist due to differences in the gene pool. The physiological and biochemical mechanisms by which this variation is expressed are still not completely understood, but are known to be significantly influenced by genotype (G), environment (E), management practices (MP), and their interactions, (Augusto et al., 2016). Understanding the interaction of these factors and how they affect seed composition and quality is crucial for maintaining high yield and quality, (Seyyed and Niyaki, 2013, and David et al., 2016).

Choice of a proper cultivar is a key factor, and plays a great role in increasing the yield advantage. Optimum planting date of soybean and selection of cultivars with high acclimation to region is one of the most important factors in agro ecological management for improving production, (Jin and Liu, 2004, and Salmeróna et al., 2016). Each suitable condition that increase in vegetative and reproductive stage duration of soybean will cause increase in rate of light interception, water and nutrient availability for plant leading increased productivity (Egli et al., 1987). Yield sensitivity to delay planting date differed among soybean genotypes and climate conditions (Oz et al., 2009). Delayed planting decreased economic return ha^{-1}(David et al., 2016; and Salmeróna et al., 2016), and produce lower 100-seed weight, and lower seed yields than early planting (Kandil et al., 2013; Scott et al., 2013; Muzammal et al., 2014, and Morsy et al., 2016). Pederson and Lauer, 2004 observed that, the start of each reproductive stage from R1 (begin flower) to R5 (begin seed) was delayed by 3 weeks in late planting date, except for stage R6 (full seed), which occurred coincidently in both planting dates at 105 day after emergence. Seed and pod numbers were greater, but seed per pod was lower, in the early May planting date.

Soybean genotypes in the mid-south is that seed from April and May planting often has low germination (Mayhew and Caviness, 1994), though seed from late-June through mid-July plantings often has acceptable quality (El-Borai et al., 2006, and Morsy et al., 2016). Thus, it may be necessary for seed producers and breeders to use late plantings to obtain high quality seed for the following year (Akhter and Sneller, 1996).

Planting dates MG IV cultivars from April to July for may produce genotypes × planting date interaction for yield and other important traits that could impact gain from selection for performance at different planting dates. Carter and Boerma , 1979 in Georgia, observed that genotypes × planting date interactions were significant for seed yield and plant height in a study of 10 MG VI to VII soybean lines planted in May and June.

Delayed planting reduces the number of days to flowering and the number of days to maturity and decreases the length of vegetative and reproductive growth stages (Board et al, 1992; and Morsy et al., 2016), long with shorter stems (Boquet, 1990), lower reproductive number of pods (Board et al., 19990), and shorter reproductive growth stage (Kantolic and Slafer, 2001, and Moosavi et al., 2011). Delayed planting generally shifts reproductive growth into less favorable conditions with shorter days and lower radiation and temperature (Egli and Bruening, 2000). The soybean growth and yield responses to planting date depend on the environment, variety and production practices. If soybean is planted too early, it may have poor emergence or limited growth because of hot temperature when soybeans are exposed to day shorter than critical length, they progress rapidly to maturing. If this occurs before the plant reaches an adequate size, the soybean is stunted and give low yield (Boquet, and Clawson, 2007, and Scott et al., 2013).

The objective of this work was to study the effects of May and June plantings on yield, yield components, seed germination and seed composition of eighteen indeterminate and determinate soybean genotypes belonging to maturity group III, IV, and V.

MATEREALS AND METHODS

A two-year field experiment was conducted during 2013 and 2014 summer seasons at the Experimental Farm of Sakha Agricultural Research Station, Kafr El-Sheikh, Egypt, to study the influence of four planting dates (May3rd, May14th, May24th, and Jun 4th) on seed yield and seed quality of 18 soybean genotypes. The studied soybean genotypes were Giza21, Giza22, Giza35, Giza82, Giza83, Giza111, Clark and Crawford (eight cultivars), H_2L_{12}, H_2L_{20}, H_1L_{10}, L105, L153, L155, H117 and DR101 (eight promising lines) and two exotic varieties (Toano and Holladay). A detailed description of the code, name, pedigree, maturity group, flower color and origin of the tested genotypes are presented in Table (1).

These genotypes belong to different maturity groups according to the American classification, i.e. Giza 35, Giza82, Giza83, H_1 L_{10}, and H117 (Maturity group III), Giza 21,Giza 22, Giza 111, Crawford, Clark, H_2 L_{20}, and H_2 L_{12} (Maturity group IV), and the others are Maturity group V. The experimental design was split plot with three replications. The planting dates were devoted to main plots and genotypes to sub plots. Each sub plot consisted of six ridges, 4 m long and 0.70 m apart. Seed of all genotypes were inoculated with the specific rhizobia prior to planting, and other agricultural practices were applied as recommended. Data were recorded on number of days from planting to 50% flowering (flowering date), number of days to 95% maturity (maturity date), and the reproductive growth stage was calculated as a difference between maturity date and flowering date (maturity date –flowering date). At harvest, a sample of ten guarded plants were randomly taken from each sub-plot to measure plant height from the soil surface to the top of the main stem (cm), and the number of pods per plant was counted as an average of the sample,

Table 1: The pedigree, maturity group, flower color and origin of tested soybean genotypes

Code No.	Genotype	Pedigree	Maturity group	Flower color	Origin
G1	Giza 21	Crawford × Celest iza 21 × Major	IV	Purple	FCRI *
G2	Giza 22	Crawford × Forrest	IV	Purple	FCRI *
G3	Giza 35	Crawford × Celest	III	Purple	FCRI *
G4	Giza 82	Crawford × Mable Presto	III	Purple	FCRI *
G5	Giza 83	Selected from MBB-133-9Union × L 76-0038 (Williams × PI 171451)	III	White	FCRI *
G6	Giza 111	Crawford × Celest	IV	Purple	FCRI *
G7	Crawford	Williams × Columbus	IV	Purple	USA ***
G8	Clark	Lincoln × Richland	IV	Purple	USA ***
G9	H_2L_{12}	Crawford × Celest	IV	Purple	FCRI *
G10	H_2L_{20}	Giza 83 × H_5L_{23}	IV	Purple	FCRI *
G11	H_1L_{10}	Giza 83 × H_2L_{20}	III	White	FCRI *
G12	L105	Giza 35 × Lamar	V	Purple	FCRI *
G13	L153	Giza 83 × Giza 21	V	Purple	FCRI *
G14	L155	L86-K-73 × Giza 21	V	Purple	FCRI *
G15	H117	D89-8940 × Giza 111	III	Purple	FCRI *
G16	Toano	Ware × Esse×	V	Purple	AES, USA
G17	Holladay	N 77-179 × Johnston	V	Purple	AES, USA
G18	DR101	Selected from Elgin	V	Purple	FCRI *

* FCRI = Field Crops Research Institute, Giza, Egypt.

** AES, USA = Agricultural Experiment Station, USA.

*** USA = U. S. Regional Soybean Laboratory at Urbana, Illinois, and Stoneville, Mississipi.

however seed yield was determined on sub-plot basis from the central four ridges in kilograms and transformed to kilograms per feddan (1 fed. = 4200m2). In addition a seed sample of 50gm from each sub-plot was randomly taken to determine 100-seed weight, standard germination, and oil and protein contents. All seed properties were carried out in collaboration with Sakha Seed Technology Research Department as follow:

Laboratory experiment:

Standard germination test was carried out according to the international rules of testing (ISTA, 1999). The germination percentage was determined on four replicates of 50 seeds for each seed sample using folded paper towels at 29^{o}C and germination counts for normal seedlings were done after seven days. The electrical conductivity (EC) of leaches from four replicates of 50 seeds weighted and soaked in 250 ml of distilled water for 24 h, was measured in µ-mhos using conductivity meter, according to the international rules (ISTA, 1999). Seed protein and oil contents (%) were determined according to procedures outlined in AOAC, 1990.

Statistical analysis:

Data were statistically analyzed according to Gomez and Gomez (1984) for split plot design for each season separately, and combined analysis over the two seasons when the assumption of errors homogeneity can not be rejected Barllett(1937).

Phenotypic stability:

The GGE Biplot method (Yan, 2001 and Yan and Kang, 2003) was employed to study the genotypes by trait two-way data in a biplot. Stability analysis was computed also according to Eberhart and Russell (1966), to detect the phenotypic stability. In data analysis genotypes were treated as fixed variables, while environments and replications were considered as random variables. A genotype having a regression coefficient (b=1), the deviation was not significantly different from zero (S^2d = zero) and above the grand mean yielding was considered stable. Besides, the following values were determinate.

a) The regression coefficient which is the regression of the performance of each genotype under different environments on the environmental mean over all genotypes were estimated as follows:

$$b_i = \sum_j y_{ij} I_j \frac{\square}{\square} \sum_j I^2 \text{(Finaly and Wilkson, 1963)}$$

$$I_j = \left(\frac{\sum_i y_{ij}}{\square} v\right) - \left(\frac{\sum_i \square \sum_j y_{ij}}{\square} v\right), \sum_j I_j = 0$$

Where:

b_i = Regression coefficient

y_{ij} = Mean performance of character on ith genotypes in jth environment j,

I_j = The environmental index,

v = Number of genotypes, and

n = Number of environments.

b) The deviations from regression can be summarized to provide an estimate of another stability parameter as follows.

$$S^2 d_i = \left[\sum_j \frac{\bar{o}_{ij}^2}{n} - 2\right] - \frac{S^2 e}{r_2}$$

$$\sum_j \bar{o}_{ij}^2 = \left[\sum_j y_{ij}^2 - \frac{y_i^2}{n}\right] - \frac{\left[\sum_j y_{ij} I_j\right]^2}{\sum_j I_j^2}$$

Where:

S^2di = Deviations from regression of each genotypes,

S^2e/r = The estimate of pooled error, and

Y_i = Total of the i[th] genotypes of all environments.

c) The second stability measurement was the coefficient of determination(R2), a statistic suggested by Pinthus(1973) which was computed from the linear regression as follows.

$$r^2 = b_i^2 \frac{S_{Ij}^2}{S_i^2} \quad \text{Wit h} \quad S_{Ij}^2 = \sum \frac{I_{Ij}^2}{m - 1}$$

Where:

r_2 = Coefficient of determination,

b_i = Regression coefficient,

S^2_i = Phenotypic variance, and

I_j = Environmental index.

RESULTS AND DISCUSSION

Ranking of genotypes, based on mean yield and stability performance:

In GGE biplot methodology, the purpose of test-environment evaluation is to effectively identify superior genotypes for a mega-environment. An "ideal" test environment should discriminate the genotypes and represent the mega-environment. Estimation of seed yield and genotypes stability shown in Figs. 1 and 2 were done by using the average environment coordinate (AEC) methods (Yan, 2001; Yan and Hunt, 2001). It visualizes the "which-won-where" pattern of Multi-Environment Yield Trials data which is important for studying the possible existence of different mega-environments (Yan, 2001). It explained PC1= 67.36%, and PC2= 19.36%, Sum= 86.72% of the total G+GE. Figure 1 cross-validated the interaction pattern of the 18 soybean genotypes with 8 environments (4 planting dates x 2 seasons). The distances from the origin (0, 0) are indicators of the amount of interaction that was exhibited by genotypes either over environments or environments over genotypes. According to the present data set, the genotypes G13, G12, G6, G2, G3,G8, G14, G5, and G15 expressed a highly interactive behavior (positively or negatively), whereas the environment of the second planting date identified the higher-yielding genotypes. The nearly additive behavior of second planting date indicated that genotypic yield in that environment was highly correlated with the overall genotypic mean across environments. The line passing in Fig. 2 through the biplot origin is called the average environment coordinate (AEC), which is defined by the average PC1 and PC2 scores for all environments (Yan and Kang, 2003). The line, which passes through the origin and is perpendicular to the AEC, represents the stability of genotypes. Either direction away from the biplot origin, on the axis, indicates greater GE interaction and reduced stability. For selection, the ideal genotypes are those with both high mean yield and high stability. In the biplot, they are close to the origin and have the shorter vector from the AEC. Thus, G12, G1, G9 and G16 genotypes were the most stable. On the other hand, the genotypes on the right side of the vertical line have yield performance greater than the mean yield and the genotypes on the left side of this line had yields less than the mean yield. In this study, the abovementioned genotypes had the higher stability as well as higher mean yield. In most cases a genotype had a high mean yield but its stability is questionable, however, the genotypes G17 and G5 had high stability but their mean yields were lower than the grand mean. These results are in agreement with those obtained by Yan *et al.*, (2007), Atnaf et *al.*, (2013); Augusto *et al.*, (2016), and Morsy *et al.*, (2016).

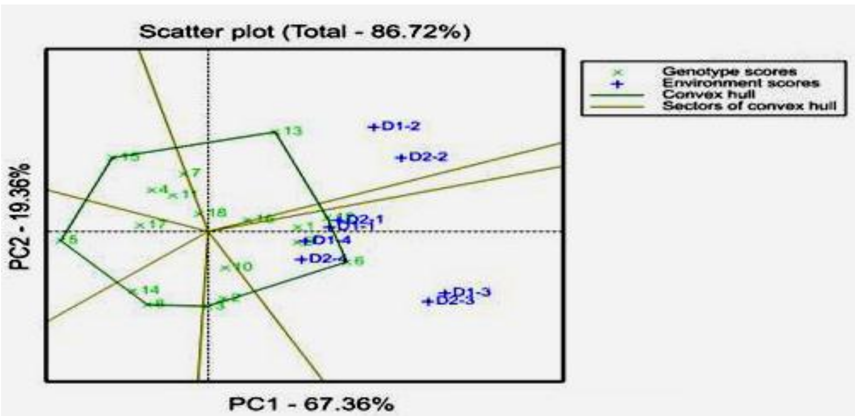

Fig. 1: The relationships among different planting dates (environments) view that, the GGE-biplot analysis showing the mega-environments and their respective high yielding genotypes.

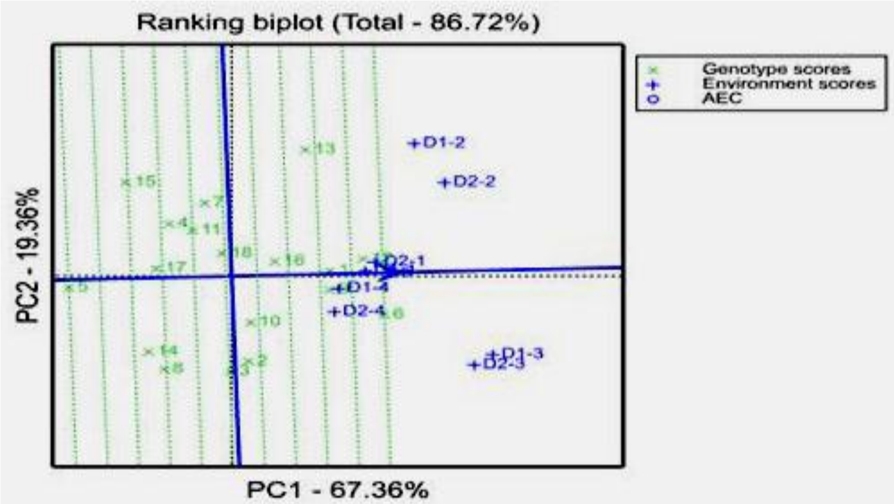

Fig. 2: Average environment coordination view of the GGE biplot based on different planting dates focused scaling for the means performance and stability of soybean genotypes.

Table(2) shows the combined analysis of variance of seed yield stability. Mean squares were highly significant among genotypes for seed yield. The environments and soybean genotype x environment interactions were highly significant for seed yield, indicating that genotypes considerably varied across environments. The mean square of genotypes x environment interactions in(Table 2) was highly significant for seed yield, indicating the presence of variability among genotypes as well as environments under which the experiments were conducted. The genotypes x environment interactions were further partitioned into linear and non-linear components. Also, the linear genotypes x environment interactions were highly significant for seed yield, indicating that genotypes differed genetically in their response to different environments when tested by pooled deviation. The pooled deviation was highly significant for seed yield indicating that the major components for differences in stability were due to deviation from-regression.

The results in (Table 3), indicate that the mean performance of seed yield for the soybean genotypes Giza21, Giza22, Giza111, H_2L_{20}, L105, L153 and Toano differed significantly from the grand mean and recorded higher yields ranging from 1634.99 kg for Toano to 1946.38kg for Giza 111. Also, results of phenotypic stability indicated that the values of regression coefficient were not significantly different from unity (b=1) for the previous genotypes expect for Giza21 and Giza111. Values of deviation from regression (S^2d) were highly significantly different from zero ($S^2d \neq 0$) for all genotypes for yield. It is evident that the genotypes which exhibited greater production had a regression coefficient equal 1 and deviation from regression significantly differed from zero, (Eberhart and Russel, 1966). Therefore all genotypes were not stable, because they had no deviation from regression ($S^2d=0$). These results indicated that, yield characters were affected by environmental conditions and at the same time the yield quantitative characters are controlled by multi-genes. Therefore, determining the suitable environment and suitable production factors for a genotype could improve productivity (x=high, b=1 and $S^2d=0$).

Table 2: The combined analysis of variance for stability for seed yield of soybean genotypes.

Source of variance	d.f.	m.s.
Genotype	17	1382329.48**
Env,Env.V	126	333931.02**
Env (linear)	1	26874727.80**
V.Env (linear)	17	220201.59**
Pooled deviation	108	106084.76**
Deviation Giza 21	6	8244.04
Deviation Giza 22	6	143075.41**
Deviation Giza 35	6	174795.82**
Deviation Giza 82	6	59628.60**
Deviation Giza 83	6	37828.29**
Deviation Giza 111	6	94194.02**
Deviation Crawford	6	150402.89**
Deviation Clark	6	136813.55**
Deviation H_2L_{12}	6	46695.11**
Deviation H_2L_{20}	6	64377.97**
Deviation H_1L_{10}	6	62563.82**
Deviation L105	6	20388.24**
Deviation L153	6	300529.12**
Deviation L155	6	100703.09**
Deviation H117	6	267026.70**
Deviation Toano	6	49662.99**
Deviation Holladay	6	136081.96**
Deviation DR101	6	58504.07**

* Significant at 0.05 level.

Table 3: Genotypes mean seed yields (kg/fed) and estimates of stability parameters.

Code	Genotype	Means (x)	Regression coefficient (b_i)	Deviation from regression (S^2d)
G1	Giza 21	1817.208	1.159+	-231747.5**
G2	Giza 22	1559.083	1.060	408745.1**
G3	Giza 35	1501.792	1.087	921453.0**
G4	Giza 82	1351.292	1.027	1086038.4**
G5	Giza 83	1090.250	0.354++	-1426370.1**
G6	Giza 111	1946.375	1.487+	2324505.5**
G7	Crawford	1440.208	1.295	3088092.4**
G8	Clark	1328.583	0.747	-671619.4**
G9	H_2L_{12}	1311.208	1.147	-278331.0**
G10	H_2L_{20}	1589.833	0.845	-1341186.2**
G11	H_1L_{10}	1465.333	0.462+	-2629744.2**
G12	L105	1898.167	1.437	2027800.8**
G13	L153	1758.000	1.317	1729369.1**
G14	L155	1313.025	0.418+	-2076771.8**
G15	H117	1247.875	0.725++	-3.95999.7**
G16	Toano	1634.958	1.405	3202168.4**
G17	Holladay	1342.583	0.534+	-1766426.6**
G18	DR101	1499.167	1.492	4848974.3**
	Grand mean	1533.052		
	LSD:(0.01)		78.08	

+, ++ indicates regression coefficient and *,** indicates the deviation from regression was significantly different from unity at 5 and 1% level of probability, respectively.

Data presented in (Table 4) show clearly that planting date had a significant effect on all studied traits. Delaying planting date from 3rd May to 4th June significantly shortened the genotype duration, i.e. the vegetative and reproductive growth stages.

Flowering and maturity dates along with the length of reproductive growth stage were significantly decreased due to delaying soybean planting date. The highest mean numbers of days to flowering and maturity (40.64 and 142.09 days) were recorded in the early planting date (May, 3rd), comparing with 30.80 and 117.67 days for the late planting date (June, 4th) in combined data. Also, the length of reproductive growth stage was significantly decreased from 102.10 days in the early planting date to 86.88 days in the late planting date in combined analysis.

Concerning studied soybean genotypes combined data in (table 4) shows that, DR 101 was the latest genotype in flowering and maturity over all planting dates and recorded 52.42 and 141.79 days, respectively. While, L105 recorded the longest reproductive growth stage (108.13 days). Although, Giza82 and Giza83 were the earliest in flowering (28.83, 28.58 days), respectively, Giza 82 and Giza 83 were the earliest genotype in maturity (126.47 and 126.79days). It was noticed also that Holladay and Toano followed DR 101 in flowering and maturity dates with slight difference. Plant height decreased with delaying soybean planting date from 95.05 to 84.14 cm. L105, L153 and L155 genotypes had the tallest plants (128.89, 132.42 and 134.06 cm, respectively), while the determinate exotic variety Holladay produced the shortest plants (50.64 cm) in the combined analysis. The number of pods was decreased with delaying planting date from 103.62 to 78.95. Giza111 cultivar and lines L105 and L153 produced the highest number of pods (133.91, 126.46 and 126.92, respectively), while Giza83 and Clark cultivars produced the lowest number of pods (71.83 and 69.16, respectively).

Data in Table (4) shows that, 100-seed weight was significantly influenced by planting date, in the combined analysis. The heaviest 100 seed- weight (17.91 g) was produced in the early planting date (May, 3rd) compared with (15.44 g) at the late planting date (June, 4) in the combined analysis. Studied soybean genotypes were significantly different in 100-seed weight over both seasons, whereas, Giza21, Giza111, L105 and L153 genotypes had the highest 100-seed weight (18.49, 19.17, 18.73 and 18.07 g, respectively), while Crawford recorded the lowest 100 seed- weight (14.45 g) in the combined analysis.

Data showed that, seed yield per fed was significantly influenced by planting date in the combined analysis, as presented in (Table 4). Over all studied soybean genotypes, the highest seed yield was obtained from plants seeded on first May. Seed yield was declined rapidly when planting date was delayed beyond the first of June. The highest seed yield (1790.90 kg fed^{-1}) was obtained from early planting date (May, 3rd) compared with (1185.25 kg fed^{-1}) at the late planting date (combined analysis).

Table 4: Effect of planting dates on flowering date, reproductive stage, days to maturity, plant height, number of pods, 100-seed weight and seed yield of soybean genotypes in combined analysis.

Character Treatment	Flowering date (day)	Reproductive stage (day)	Maturity date (day)	Plant height (cm)	No. of pods	100-seed weight (g)	Seed yield (kg)
Planting date							
May 3	40.64	102.10	142.09	95.05	103.62	17.91	1790.90
May 14	36.95	101.45	139.05	89.73	103.02	17.44	1743.63
May 24	34.01	99.75	133.76	84.99	100.69	16.47	1412.57
June 4	30.80	86.88	117.67	84.14	78.95	15.44	1185.25
L.S.D $_{(0.01)}$	0.2144	0.8694	2.8361	1.97	6.69	1.41	61.81
			Genotype				
Giza 21	33.75	98.33	132.08	95.08	108.49	18.49	1817.21
Giza 22	33.79	103.68	137.47	84.65	89.16	16.57	1559.08
Giza 35	29.13	97.81	126.94	81.97	83.94	16.22	1501.79
Giza 82	28.58	97.89	126.47	71.86	85.83	16.34	1351.29
Giza 83	28.83	97.96	126.79	82.37	71.83	16.64	1090.25
Giza 111	33.00	96.19	129.19	89.72	133.91	19.17	1946.38
Crawford	31.00	98.00	129.00	71.21	94.32	14.45	1440.21
Clark	30.96	96.33	127.29	72.42	69.16	15.73	1328.58
H_2L_{12}	32.29	98.84	131.13	91.29	109.65	17.30	1811.21
H_2L_{20}	33.71	98.27	131.98	86.11	94.53	16.67	1589.83
H_1L_{10}	30.50	96.71	127.21	81.33	86.90	15.97	1465.33
L105	33.79	105.38	139.17	128.89	126.46	18.73	1898.17
L153	33.83	106.59	140.42	132.42	126.92	18.07	1758.00
L155	41.75	106.71	148.46	134.06	88.98	16.01	1313.63
H117	30.04	97.06	127.10	87.10	81.74	15.82	1247.88
Toano	46.71	106.79	151.50	83.76	103.54	17.26	1634.96
Holladay	48.11	107.47	153.58	50.64	85.95	16.56	1342.58
DR101	48.42	107.37	155.79	67.69	96.97	16.65	1499.17
L.S.D$_{(0.01)}$	0.301	0.567	0.223	4.66	8.95	1.26	78.08

*, ** and NS indicated P<(0.05%), P<(0.01%) and not significant, respectively.

The studied soybean genotypes differed in their seed yield per fed. that, Giza 111 and L105 genotypes had the highest seed yields (1946.38 and 1898.17 kg fed^{-1}, respectively), over the different planting dates, followed by Giza 21, and H_2 L_{12} (1.817 and 1.811 ton fed^{-1}, respectively), while Giza83 had the lowest seed yield (1090.25 kg fed^{-1}), in the combined analysis.

Data in Table (5) show that there was significant effect of interaction between planting date and genotypes on flowering date, reproductive stage and maturity date in combined data. Line DR101 was the latest in flowering date (58.17 day), at the early planting date, while Giza82, Giza83, H_1L_{10} and H117 were the earliest in flowering date (24.33, 24.17, 24.33 and 24.33 day, respectively), at the late planting date in combined analysis. The length of soybean reproductive growth stage was significantly affected by the interaction of planting dates and soybean genotypes. The length of the reproductive growth stage of H117 was the highest (116.17 days) in the first planting date (May,3rd), while DR101 and L105 lines with late planting date (June,4th) recorded the lowest period (79.83 and 79.67 days) in combined data. Maturity duration was the longest with Toano in the early planting date (152.52 day), while the shortest periods were record by Giza82 and H_2L_{20} (109.33 and 109.33 days) in late planting date (combined data).

Data in Table(6) show that there was significant interaction effect for planting dates and genotypes on plant height, number of pods and 100-seed weight in combined data. Lines L155, L153 and L105 lines recorded the highest plant height in the early planting date (145.88, 138.71 and 136.91 cm respectively), while Holladay, DR101, Toano and Giza83 gave the lowest plant height in the late planting date (41.66, 48.33, 48.87 and 47.53 cm respectively). Giza111, L105 and L153 produced the highest number of pods (139.08, 149.25 and 154.00) under early planting, while Giza35, Giza82, Giza83 and Clark recorded the lowest number of pods under late planting (58.00, 62.46, 55.36 and 54.89) in combined data. Giza111, H_2L_{12}, L105,Toano and DR101 under early planting gave the highest 100-seed weight (21.00, 19.11, 19.64, 18.86 and 19.15 g respectively), in combined data, while Giza35, Giza83, Crawford, Clark, H_2L_{12}, H_2L_{20}, H_1L_{10}, L155 and DR101 in late planting date gave the lowest values (14.76, 13.33, 14.38, 14.31, 14.74, 14.56, 14.34, 14.38 and 13.96 g respectively). The previous results support the hypothesis that soybean yield would increase at the early planting date, which was mainly driven by increased 100-seed weight. Early planting dates allowed the vegetative and reproductive periods to start earlier, and to be longer than late planting dates which contribute to increased seed yields according to(Wilcox and Frankenberger, 1987; Cooper, 2003; De Bruin and Pedersen, 2008; Elgi and Cornelius, 2009, and Kandil *et al*., 2013); they add also that, the point of rapid decline in soybean yield begins on May 30th in the Midwest.

Table 5: Interaction effect of planting dates and soybean genotypes on flowering date, reproductive stage and maturity date (days) in combined analysis.

Character	Flowering date (days)				Reproductive stage (days)				Maturity date (days)			
Genotype	May3	May14	May 24	June4	May3	May14	May24	June4	May3	May14	May24	June4
Giza 21	39.17	35.17	31.33	29.33	99.33	97.16	94.67	91.33	138.50	132.33	126.00	120.66
Giza 22	39.33	35.17	31.33	29.33	97.50	101.16	99.08	90.00	136.83	136.33	130.41	119.33
Giza 35	33.33	30.50	28.33	24.33	107.50	102.83	94.67	85.67	140.83	133.33	123.00	110.00
Giza 82	33.50	29.33	27.33	24.17	100.16	104.00	96.17	86.49	133.66	133.33	123.50	110.66
Giza 83	33.33	30.33	27.33	24.33	104.83	99.00	96.17	89.56	138.16	129.33	123.50	113.89
Giza 111	36.33	32.17	31.33	29.33	99.83	100.16	99.50	86.22	136.16	132.33	130.83	115.55
Crawford	36.17	32.17	29.33	26.33	100.16	99.74	100.33	86.50	136.33	131.91	129.66	112.83
Clark	36.17	32.17	29.17	26.33	102.16	100.16	100.49	83.67	138.33	132.33	129.66	110.00
H_2L_{12}	36.33	32.17	29.17	26.33	102.33	97.99	96.49	91.92	138.66	130.16	125.66	118.25
H_2L_{20}	39.17	35.17	31.33	29.17	101.33	101.16	98.50	80.16	140.50	136.33	129.83	109.33
H_1L_{10}	36.17	32.17	29.33	24.33	99.33	101.16	101.33	85.00	135.50	133.33	130.66	109.33
L105	39.33	35.17	31.33	29.33	106.17	105.33	104.67	95.67	145.50	140.50	136.00	125.00
L153	39.33	35.33	31.33	29.33	106.00	105.17	105.50	95.67	145.33	140.50	136.83	125.00
L155	50.17	47.17	45.33	40.33	100.49	98.16	95.33	79.67	150.66	145.33	140.66	120.00
H117	33.17	31.33	29.33	26.33	100.49	99.50	101.33	86.92	133.66	130.83	130.66	113.25
Toano	52.17	48.17	44.17	42.33	98.33	96.99	96.49	87.67	150.50	145.16	140.66	130.00
Holladay	54.17	49.33	45.17	43.17	96.83	100.83	95.83	81.83	151.00	150.16	141.00	125.00
DR101	55.17	49.17	45.17	44.17	97.33	96.16	95.83	85.83	152.50	145.33	141.00	130.00
$L.S.D_{(0.01)}$ (dxc)				0.6031				1.133				0.548

Table 6: Interaction effect of planting date and soybean genotypes on plant height, number of pods and 100-seed weight in combined analysis.

Character	Plant height (cm)				No. of pods				100-seed weight (g)			
Genotype	May 3	May14	May24	June4	May3	May14	May24	June4	May3	May14	May24	June 4
Giza 21	113.41	100.16	87.26	79.47	132.16	116.96	101.42	83.40	19.81	18.98	18.09	17.04
Giza 22	104.50	88.04	83.83	62.22	100.23	90.66	88.07	77.66	18.09	17.31	15.72	15.14
Giza 35	86.60	81.15	81.00	79.12	109.64	90.11	77.98	58.00	17.72	17.38	14.99	14.76
Giza 82	83.79	82.44	73.66	47.53	98.33	95.61	86.91	62.46	17.83	16.37	15.85	15.29
Giza 83	79.68	68.14	92.33	89.34	83.73	83.45	64.75	55.36	15.57	14.84	14.04	13.33
Giza 111	97.25	96.75	92.71	72.14	139.08	136.24	135.20	125.13	21.00	19.43	18.15	18.09
Crawford	90.80	81.26	58.00	54.74	104.73	107.33	90.93	77.30	18.41	17.16	15.56	14.38
Clark	75.66	74.88	70.44	68.66	81.07	78.05	62.59	54.89	17.59	16.18	14.83	14.31
H_2L_{12}	100.16	99.91	84.46	80.63	126.91	113.83	99.83	98.03	19.11	18.33	17.00	14.74
H_2L_{20}	100.82	90.41	82.71	70.50	105.18	104.30	95.85	72.80	18.30	16.97	16.83	14.56
H_1L_{10}	89.83	87.46	81.00	67.00	97.85	93.50	79.85	76.36	18.25	15.91	15.37	14.34
L105	136.91	127.35	126.50	125.76	149.25	144.94	129.68	81.97	19.64	18.84	18.68	17.73
L153	138.71	133.16	129.60	128.16	154.00	131.99	113.13	108.53	18.34	18.23	18.22	17.36
L155	145.88	137.33	126.50	126.10	104.43	101.08	82.165	68.25	16.95	16.26	16.01	14.38
H117	114.20	101.01	70.51	62.66	94.41	84.70	78.50	69.35	17.37	16.82	16.70	12.38
Toano	59.16	55.63	54.69	48.87	127.91	103.40	101.26	81.56	18.86	17.03	16.82	16.29
Holladay	57.18	53.01	50.67	41.66	106.44	92.77	75.00	69.55	17.56	16.47	16.12	16.05
DR101	87.92	79.33	55.18	48.33	108.34	112.50	91.43	75.60	19.15	17.19	16.29	13.96
$L.S.D_{0.01}$(dxc)					9.31			17.91				2.52

Data in Table(7) show that there was significant interaction effect for planting dates and genotypes on seed yield in combined data. Giza111 produced the highest seed yield per fed. (2519.16 kg fed^{-1}) in the early planting date, while Giza82, Giza83, Crawford, H117, Toano, Holladay and DR101 recorded the lowest seed yields per fed. (975.33, 929.66, 1060.00, 997.16, 1084.66, 1002.33 and 10.32.16 kg fed^{-1}) under the late planting date.

The percentage of seed germination showed highly significant response to planting date and soybean genotypes. Delaying planting date from May 3rd to June 4th significantly increased the percentage of seed germination over all studied soybean genotypes from 70.25 to 91.93 %, in combined analysis as presented in Table (8). Data indicated also that, delaying soybean planting date significantly decreased seed E.C. from 59.10 to 29.66 µ-mhos (combined data). In this aspect, Green et al. (1965) concluded that soybean seed obtained from later planting dates, which reached maturity after hot dry weather had ended, generally exhibited higher germination and field emergence than that matured during hot dry weather. Soybean genotypes differed significantly in the percentage of seed germination, that DR101 recorded the highest value (89.96%), followed by Clark (85.96%), L105 (85.50%) and H117 (85.75%) in the combined analysis, while Giza21 (73.88 %), Giza22 (73.25 %) and Giza83 (74.75 %) gave the lowest value of this trait over the different planting dates. On the other hand, data in (Table 8) show that, Clark recorded the lowest value of E.C. than other genotypes, while Giza83 recorded the highest value of this trait across the different planting dates.

Data presented in (Table 8) indicate that, delaying soybean planting date significantly decreased seed oil content from 23.1 to 19.58%, while protein content was significantly increased from 34.80 to 39.06%. This result could be explained by the conclusion of Burton (1985) that oil and protein contents of soybean are negatively correlated. The more viable seeds were significantly the higher in protein content in both seasons. Our results agree favorably with other researchers, who found a decrease in oil content and a general increase in protein content as planting is delayed (Bastidas *et al.*, 2008; Kane *et al.*, 1997; and Robinson *et al.*, 2009). The determinate genotype Toano recorded the highest oil content (22.02%), while DR101 was the lowest in this trait (17.67 %) in combined analysis. L153 and DR101 gave the highest protein content (38.61, 38.43 %), respectively, while H_2L_{12} produced the lowest protein content (33.06%) in combined analysis.

Data in table (9) show that, soybean seed viability expressed as percentage of seed germination and E.C. values were significantly affected by the interaction of planting dates and soybean genotypes in combined analysis. The highest germination percentages (96.16, 97.50 and 96.16 %) were recorded by Toano, Holladay and DR101 in the late planting date (June, **4th**), while the lowest value (49.53%) was recorded by Giza35 in the early planting date (May, 3rd). This wide variation could be attributed to the difference in maturity duration of both genotypes, that Toano, Holladay and DR101 are a determinate growth types belong to maturity group V, while Giza35 is classified as an early maturity group III genotype.

Table 7: Interaction effect of planting dates and soybean genotypes on seed yield in combined analysis.

Character	**Seed yield (kg/fed)**			
Treatment	**May 3rd**	**May 14th**	**May 24th**	**June 4th**
Giza 21	2123.83	2050.83	1673.00	1421.16
Giza 22	2081.00	1521.16	1414.16	1220.00
Giza 35	2069.16	1449.83	1309.50	1178.66
Giza 82	1731.00	1459.50	1239.33	975.33
Giza 83	1168.50	1167.66	1095.16	929.66
Giza 111	2519.16	2117.16	1611.83	1537.33
Crawford	1957.16	1605.50	1138.16	1060.00
Clark	1771.66	1252.33	1154.83	1135.50
H_2L_{12}	2182.00	2029.66	1528.33	1504.83
H_2L_{20}	1920.83	1633.50	1504.83	1300.16
H_1L_{10}	1740.50	1423.00	1414.50	1283.33
L105	2264.16	2187.50	1788.16	1352.83
L153	2321.16	1747.50	1838.16	1125.16
L155	1591.16	1369.16	1176.00	1118.16
H117	1778.33	1142.83	1073.16	997.16
Toano	1985.00	1894.00	1576.16	1084.66
Hollday	1542.83	1439.00	1386.16	1002.33
DR101	1938.50	1795.16	1230.83	1032.16
L.S.D $_{(0.01)\ (dxv)}$	156.20			

Table 8: Some seed quality properties of soybean genotypes as affected by four planting dates.

Character	Germination (%)	E.C	Oil (%)	Protein (%)
Planting date				
May 3rd	70.25	59.10	23.14	34.80
May 14th	76.44	44.49	21.34	35.48
May 24th	83.76	36.65	20.59	37.21
June 4th	91.93	29.66	19.58	39.06
L.S.D ($_{0.01}$)	1.424	0.363	0.210	0.299
Genotypes				
Giza 21	73.88	49.04	20.60	35.67
Giza 22	73.25	50.44	21.75	37.09
Giza 35	76.71	45.69	21.10	35.36
Giza 82	79.42	44.16	21.14	37.01
Giza 83	74.75	48.95	21.46	35.82
Giza 111	85.96	35.88	21.09	34.28
Crawford	78.83	45.02	20.80	37.56
Clark	85.96	35.09	19.65	37.53
H_2L_{12}	76.04	47.86	20.57	33.06
H_2L_{20}	75.42	48.17	19.89	37.82
H_1L_{10}	82.46	39.76	20.27	36.73
L105	85.50	37.93	19.05	37.12
L153	81.96	43.25	21.76	38.61
L155	84.21	38.23	19.84	37.83
H117	85.75	37.8	18.36	37.05
Toano	82.17	40.79	22.02	35.27
Holladay	80.79	43.76	19.27	37.30
DR101	89.96	32.72	17.76	38.43
L.S.D ($_{0.01}$)	1.216	0.673	0.667	0.266

*, ** and NS indicated P<0.05%, P<(0.01%) and not significant, respectively.

Table 9: Interaction effect of planting dates and soybean genotypes on germination percentage and electrical conductivity in combined analysis.

Character	Germination (%)				E.C			
Treatment	**May3**	**May14**	**May 24**	**June 4**	**May3**	**May14**	**May 24**	**June 4**
Giza 21	52.50	70.16	81.16	91.66	84.36	40.39	38.43	32.16
Giza 22	52.00	64.33	78.50	85.50	83.00	51.15	38.66	28.07
Giza 35	63.50	70.50	80.00	90.16	61.90	50.53	38.90	30.42
Giza 82	69.50	78.66	81.50	88.00	59.66	44.48	40.06	31.39
Giza 83	65.83	74.00	80.83	81.00	80.57	46.36	39.37	28.53
Giza 111	78.16	83.00	89.16	91.66	44.76	35.11	33.02	29.92
Crawford	54.83	78.50	88.50	93.50	59.84	49.89	38.38	31.09
Clark	76.00	81.16	89.16	90.50	42.24	39.85	31.13	26.46
H_2L_{12}	71.66	76.50	77.33	82.16	79.61	44.21	37.36	29.53
H_2L_{20}	72.33	72.00	80.00	91.83	67.19	52.70	40.08	31.96
H_1L_{10}	78.33	79.83	80.00	91.66	49.42	41.63	35.78	31.24
L105	78.16	83.18	89.64	92.66	54.81	35.14	33.53	27.29
L153	73.50	80.50	85.66	88.16	59.57	44.42	37.59	30.35
L155	78.50	79.83	87.50	92.00	45.74	39.90	38.37	28.07
H117	81.83	83.50	86.83	89.83	52.06	42.89	30.98	24.42
Toano	78.33	81.66	83.16	98.16	54.28	45.91	33.75	28.31
Holladay	67.50	76.50	87.33	97.50	52.41	50.51	38.22	33.98
DR101	83.66	86.16	88.83	96.16	42.03	32.75	28.51	26.55
L.S.D $_{0.01)dxv}$	2.423				1.345			

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Table 10: Interaction effect of planting dates and soybean genotypes on oil and protein contents in combined analysis.

Character	Oil (%)				Protein (%)			
Treatment	**May3**	**May14**	**May 24**	**June 4**	**May3**	**May14**	**May 24**	**June 4**
Giza 21	23.10	20.62	19.62	18.76	34.97	35.47	35.64	36.56
Giza 22	22.07	21.74	20.03	18.15	35.81	36.25	37.31	38.97
Giza 35	21.09	20.65	20.53	20.03	33.50	34.05	34.31	39.58
Giza 82	21.12	20.95	20.42	20.29	34.58	37.11	37.83	38.49
Giza 83	21.44	20.96	20.82	20.61	33.71	35.89	36.35	37.32
Giza 111	22.14	21.08	20.59	17.69	32.54	34.20	34.71	35.64
Crawford	22.82	20.78	20.50	20.04	36.26	36.71	37.52	39.74
Clark	19.97	19.63	19.48	20.45	35.46	36.45	37.06	41.14
H_2L_{12}	21.57	20.56	19.96	18.65	31.51	32.32	33.72	34.66
H_2L_{20}	20.22	20.20	19.88	19.64	34.38	35.95	38.63	42.30
H_1L_{10}	21.10	20.86	20.26	20.04	34.44	36.94	37.53	37.99
L105	20.79	20.14	19.30	19.03	33.78	36.41	38.55	39.73
L153	21.73	20.87	20.76	20.19	33.43	35.65	41.68	43.66
L155	20.10	19.83	19.62	19.24	35.62	37.43	37.97	40.28
H117	20.02	19.64	18.36	17.72	33.47	36.62	39.60	38.48
Toano	22.45	22.00	22.02	21.75	33.65	34.30	36.39	36.74
Holladay	22.06	21.66	19.25	18.70	33.49	35.02	37.36	43.32
DR101	20.96	19.41	17.75	17.43	34.33	36.50	39.67	43.17
L.S.D ($_{0.01)\ (dxv)}$)	1.335				0.532			

These results demonstrated that seeds of the long-duration genotypes are more viable than those of the short-duration genotypes. Our results agree favorably with other researchers, who found an increase in seed germination as planting is delayed (Green et al., 1965; Tekrony et al., 1984; Avila et al., 2003; El-Borai et al., 2006; Kandil et al., 2013; and Rahman et al., 2013).

The lowest electrical conductivity (24.42 µ-mhos) was recorded by Holladay in the late planting date (June, 4th), while the highest value (84.36 µ-mhos) was recorded by Crawford in the early planting date (May,3 rd). There was a negative relationship between the germination percentage and electrical conductivity.

Data in table (10) show that, oil and protein contents were significantly affected by the interaction of planting dates and soybean genotypes in combined analysis. The highest oil contents (23.10, 22.07, 22.14, 22.82, 22.45 and 22.06 %) were recorded by Giza21, Giza22, Giza111, Crawford, Toano and Holladay in the early planting date (May, 3rd), whereas the lowest values (18.76, 18.15, 17.69, 18.65, 17.72, 18.70 and 17.43%) were recorded by Giza21, Giza22, Giza111, H_2L_{12}, H117, Holladay and DR101 genotypes in the late planting date (June, 4th). The highest protein contents were recorded by L153, Holladay and DR101 genotypes (43.66, 43.32 and 43.17 %) in the late planting date, while the lowest values (31.51%) was recorded by H_2L_{12} in the early planting date in combined analysis.

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الملخص العربي

الثبات الوراثي لمحصول وجودة البذور لبعض التراكيب الوراثية لفول الصويا تحت مواعيد الزراعة المختلفة

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أجريت هذه الدراسة في محطة البحوث الزراعية بسخا– كفرالشيخ– مصر، خلال موسمي الزراعة الصيفي ٢٠١٣ و٢٠١٤م لدراسة تأثير أربعة مواعيد زراعية هي ٣ مايو، ١٤ مايو، ٢٤ مايو، و٤ يونيو على إنتاجية وجودة بذور ثمانيه عشر تركيب وراثي من الفول الصويا وهي ثمانية أصناف تجارية هي جيزة ٢١ و جيزة ٢٢ و جيزة

٣٥ وجيزة ٨٢ و جيزة ٨٣ و جيزة ١١١وكلارك وكراو فورد، وثمانية سلالات مختارة من برنامج التربية هي H_2L_{12}, H_2L_{20}, H_1L_{10}, L105, L153, L155, H117, DR101 وصنفين مستوردين هما Holladay و Toano .

أظهرت نتائج تحليل GGE biplot أن التراكيب الوراثية جيزة٢١، L105، H_2L_{12}، Toano، DR 101 اعطت محصول أعلى من المتوسط العام وكانت أكثر التراكيب الوراثية ثباتا تحت مواعيد الزراعة المختلفة.

أظهرت نتائج التحليل المجمع للبيانات أن تأخير ميعاد الزراعة من أول مايو حتى أول يونيو أدى إلى انخفاض معنوي في عدد الأيام حتى التذهير والنضج من ٤٠.٤٦ و١٤٢.٠٩ يوم إلى ٣٠.٨٠و ١١٧.٦٧ يوم على التوالي مما أدى إلى انخفاض فترة النمو من ١٠٢.١٠الى ٨٦.٨٨ يوم على التوالي وانخفاض طول النبات من ٩٥.٠٥ إلي ٨٤.١٤ سم وعدد القرون من ١٠٣.٦٢ إلي ٧٨.٩٥ وانخفاض وزن ١٠٠بذرة من ١٧.٩٠جرام إلى ١٥.٤٤ جرام ومحصول البذرة للفدان من ١٧٩٠.٩٠ إلى ١١٨٥.٢٥ كجم. وعلى العكس فان محتوى البذور من البروتين ونسبة الإنبات قد ارتفع من ٣٤.٨٠ و٧٠.٢٥% إلى ٣٩.٠٦ و٩١.٩٣ % على التوالي ،بينما انخفض محتوى الزيت من ٢٣.١٤ إلي ١٨.٥٨ % وانخفض التوصيل الكهربي من ٥٩.١٠ إلي ٢٩,٦٦ ميللموز بتأخير ميعاد الزراعة.

اختلفت التراكيب الوراثية لفول الصويا تحت معاملات الدراسة المختلفة ، حيث كان التركيب الوراثي DR101 الأكثر تأخرا في ميعادي التذهير والنضج ٤٨,٤٢ و١٥٥.٧٩يوم على التوالي .بينما جيزة ٢١و جيزة ١١١ و L105 and L153أعطت أعلى قيمة لوزن ١٠٠بذرة ١٨.٤٩و ١٩.١٧و ١٨.٧٣ و١٨.٠٧ علي التوالي، بينما كان الصنف جيزة ٨٢ و جيزة ٨٣ أبكر في ميعا النضج ١٢٦.٤٧ و١٢٦.٧٩ يوم و أقل في وزن ١٠٠ بذرة ١٤.٤٥ جرام. الصنف التجاري جيزة ١١١ والسلالة L105 أعلي محصول بذور (١٩٤٦.٣٨ و١٨٩٨.١٧ كجم/فدان). جيزة ١١١و السلالة L105, L153 أعطت أعلي عدد القرون للنبات (١٣٣.٩١و ١٢٦.٤٦و١٢٦.٩٢)، بينما كانت السلالتين L105, L153 أكثر النباتات طولا (١٣٢.٤٢ و١٣٤.٠٦ سم). أظهرت النتائج أيضا أن السلالة DR101 كانت الأفضل في نسبة الإنبات المعملي حيث كانت ٨٩.٩٦% كما أنخفضت السلالة DR101 في نسبة التوصيل الكهربي للبذرة حيث كانت (٣٢.٧٢ ميللموز) والصنف تونو أعطي أعلي نسبة زيت حيث كانت (٢٢.٠٢%) والسلالة L153 , DR101 أعطوا أعلي محتوي بروتين للبذرة (٣٨.٦١ و٣٨.٤٣%).

يتضح مما سبق أن التراكيب الوراثية جيزة ٨٢ وكلارك و L105, H117 ، Toano, DR101 يمكن أفضل محصول جيد مع نسبة أنبات تزيد عن ٨٠% عندزراعتها في أول يونيو بينما التراكيب الوراثية وهي جيزة ٢١و جيزة ٢٢ وجيزة ٨٣ وجيزة ١١١ وكراوفورد وكلارك وهوليداي و H_2L_{12} , L155 يجب أن تزرع في أول مايو لإنتاج عالي مع جودة وحيوية بذور مرتفعة.