Assiut J. Agric. Sci., 52 (5) 2021 (64-75) *ISSN: 1110-0486*
Website:www.aun.edu.eg/faculty_agriculture/journals_issues_form.php *E-mail: ajas@aun.edu.eg*

Impact of Proline Foliar Spray on Yield and its Components of Some Soybean Genotypes Under Newly Reclaimed Soils

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Accepted for publication on: 17/3/2022

Abstract

A field experiment was carried out during 2020 and 2021 seasons at Al-Marashda Agricultural Research Station, Qena Governorate, A.R.C, Egypt. The objective of this work was to evaluate the yield and its components as well as seed protein and oil content in four soybean genotypes to foliar application of different proline levels. The four studied soybean genotypes were, Giza 111, H18L54, H1L3, and H3L4, while the four concentrations of proline were 0, 25, 50, and 75 ppm. The field experiment was assigned in a strip plot design with three replications. Proline concentrations were allocated horizontally while soybean genotypes were distributed vertically. The obtained results indicated that the foliar application of proline levels caused a significant increase in the yield and its components as well as studied chemical traits of soybean genotypes compared to untreated plants in favor of 50 ppm concentration. Moreover, the highest mean values of soybean yield were recorded with Giza 111 followed by H18L54 genotypes in the first and second seasons, respectively. It was noticed that foliar application of proline at the rate of 50 to G111 genotypes resulted in the highest mean values of yield parameters as well as protein and oil percentage traits in both seasons.

***Keywords**: Soybean genotypes, proline, yield, component, protein, oil content.*

Introduction

Soybean (*Glycine max*. L.), considers one of the most serious soil seed crops of the world due to its high food value. It contains approximately 36-40% protein, 18-20% oil, 30% carbohydrates, 7.3% sugar, and 9.3% dietary fiber and also contains minerals such as Ca and P, vitamins as A, B, C, and D (Ferdous, 2016). In Egypt, soybeans are not grown on a large area; in the 2019 season, it was planted on 24,000 fed (10,080 hectares) mostly in Upper and Central Egypt, of which about1.5 percent was on new lands (OSPA, 2019). Recently, there is a pretentious plan in Egypt to increase the agricultural area by reclaiming desert land to increase the production of agricultural crops to reduce the gap between consumption and production due to the steady increase in population.

Many stresses face desert lands, such as water shortage and salinity. However, salinity affects plant growth by reducing water supply, low uptake, and accumulation of essential nutrients, and raising the toxic ions accumulation like sodium and chloride in cells of plants (Munns, 2005). However, the number of nodules in legume crops was highly decreased in salt-affected soils even though native Rhizobia are present in the rhizosphere (EL Sabagh *et al*., 2017). Soybean is sensitive in symbiotic N2-fixation under drought conditions (Nandwal *et al.,* 1991).

Many studies have been prepared to reduce the damage caused to plants by stress and to increase the tolerance against stress. Proline, an amino acid, plays a highly beneficial function in plants exposed to various stress conditions. Next to acting as an excellent osmolyte, proline plays three major roles during stress, i.e., as a metal chelator, an antioxidative defense molecule, and a signaling molecule (Hayat *et al*., 2012). Previous investigations have shown that foliar spray with proline effectively regulates osmotic potential and plays an important role in sustaining plant growth under osmotic stress (Ashraf and Foolad, 2007). However, Munns and Tester (2008) revealed that one of the mechanisms used by plants that can reduce the damaging effects of high cellular ion concentrations is the stress-induced synthesis of harmonic osmolytes including proline that does not impede normal metabolic reactions within the cell. Foliar spray of amino acid on bean plants was significantly improved all studied parameters due to seawater stress. The highest level of amino acid at the rate of 1500 mg/ L exerted the strongest effect in alleviating the harmful effects of seawater stress (Sadak *et al*., 2015). Here too, Sadak *et al*. (2020) focused that Cysteine treatments could alleviate the adverse effect of salinity stress on the growth and yield of soybean plants via increasing photosynthetic pigments; proline content; N, P, and K contents. Ismail and Helmy (2018) suggested that spraying broad bean plants grown under saline soil by 100 mg proline/L improved growth traits and yield in addition to chemical components. As a result, the main objective of this work was to determine the efects of different proline concentrations, as an exogenous application on the yield and its components as well as seed protein and oil content of some soybean genotypes under newly reclaimed soil conditions.

Materials and Methods

This investigation was carried out at Al-Marashda Agricultural Research Station, Qena Governorate, Agriculture Research Center, Egypt during 2020 and 2021 seasons. The objective of this research was to study the effects of different proline concentrations on the yield and its components as well as protein and oil percentage of some soybean genotypes. The characterization of these genotypes is presented in Table 1. The chemical analysis of the experimental soil site and the irrigation water used were shown in Tables 2 and 3, respectively.

Table 1. Description and pedigree of soybean genotypes used in the study.

Genotypes	**Pedigree**	**Maturity group**
Giza 111	Crawford x Celest	IV group
H18L54	Crawford xDekabig	IV group
H3L4	H20L3 x Gassoy17	V group
H1L3	H2L20 x Major	V group

Table 2. Some of the physical and chemical properties of the experimental soil site.

Texture class	Particle size distribution			$CaCO_3$ %		EC(dSm^{-1} (1 : 2.5)	pH(1-5)
	Sand %	Silt %	Clay %				
Sandy	81.3	12.7	6.0	12.55		3.01	8.08
Cation (meq L^{-1})				Anion (meq L^{-1})			
Na^+	K^+	Ca^{++}	Mg^{++}	CO_3^{--}	HCO_3^-	Cl^-	SO_4^{--}
30.02	0.88	12.0	6.2	0.0	0.82	30.6	17.9

Table 3. Water analysis of the irrigation water (drip irrigation) used for the experimental site.

TDS mg/l	pH	EC(dSm^{-1}) (1:2.5)	Soluble cations (mg/l.)				Soluble anions (mg/l.)			
			Ca^{++}	Mg^{++}	Na^+	K^+	CO_3^{--}	HCO_3^-	$SO4^{--}$	CL^-
225.5	7.3	3.25	28.5	8.8	31.6	6.2	24.7	110.5	41.6	31.2

Experiment design and treatments:

A field experiment was assigned in a strip plot design with three replications. The soybean genotypes i.e. Giza 111, H18L54, H1L3, and H3L4 were distributed vertically. Meanwhile, the proline concentrations (0, 25, 50, and 75 ppm)were allocated horizontally. Each experimental unit area was 10.5 m^2 included 4 ridges each of 50 cm width, 50 cm between them, and 3.5 m length. Seeds of soybean genotypes were obtained from Legume Dept., Field Crops Res. Instit., A.R.C., Egypt. Seeds were sown in hills on May 10th in the two growing seasons. Three weeks after, only two healthy seedlings remained on each hill. Nitrogen fertilizer in the form of urea (46.5% N) at the rate of 60 kg N fed^{-1} and potassium fertilizer as potassium sulfate (48% K_2O) at the rate of 48 kg K_2O fed^{-1} were applied in the two equal doses (after thinning and three weeks later). Foliar application with proline concentrations was carried out three times at aforesaid levels after 20,35, and 50 days after sowing.

The other cultural practices recommended for soybean crop was done in both seasons.

Measurement's traits:

A- Yield and its components

At harvest, a random sample of ten plants was taken from each experimental unit to measure, the number of pods $plant^{-1}$, the weight of pods $plant^{-1}$ (g), number of seeds pod^{-1}, the weight of 100-seed (g), seed yield $plant^{-1}$ (g), and seed yield (ton)/ fed. Harvest index.

B- Chemical traits:

The seed's protein contents were determined according to the method described by Bradford (1976).

For oil content, samples were taken (400–500 g intact soybean seeds) to determine the oil content via near-infrared reflectance spectroscopy (NIRS, Polytec PSSSHA03-2.1) as described by Pazdernik *et al.* (1997).

Statistical analysis:

All collected data were analyzed with analysis of variance (ANOVA) Procedures, using the SAS Statistical Software Package v.9.2 (SAS, 2008). Differences between means were compared by least significant difference (LSD) at a 5% level of significance (Gomez and Gomez, 1984).

Results and Discussion

1-Pods number and weight $plant^{-1}$:

Data in Tables4 and 5 show that pods number and weight/ plant traits of soybean differed significantly due to different studied soybean genotypes and proline concentrations, while the interaction had a significant effect on pods weight/plant trait in both seasons. Proline application at the rate of 50 ppm or 75 ppm on soybean plants produced the highest mean values of pods number and weight/ plant compared to the other studied proline concentrations. Moreover. The highest mean values of pods number and weight/ plant were recorded from G111 followed by H18L54, while var. H3L4 produced the lowest ones in both seasons. Concerning the effect of interaction between proline levels and soybean genotypes, the highest mean values of the number and weight of pods/ plant were due to spraying var. G111 by proline at 50 ppm, while the lowest ones were due to untreated plants of variety H3L4. These results were in agreement with those of Rady *et al.* (2016) and Tabassum *et al.* (2018). In this respect, El-Sabagh *et al.* (2015) noticed that the G111 soybean cultivar produced the highest number of pods per plant than that of other cultivars.

Table 4. Means of pods number/ plant of soybean as affected by genotypes, proline concentrations) and their interaction in 2020 and 2021 seasons.

Genotypes(G)	Proline (P)									
	2020 season					2021 season				
	Control	25 ppm	50 ppm	75 ppm	Mean	Control	25 ppm	50 ppm	75 ppm	Mean
1 G 111	62.37	64.83	73.70	68.20	67.28	63.60	64.87	71.47	69.27	67.30
2H18L54	57.97	62.30	67.80	66.90	63.74	62.97	63.90	66.40	67.10	65.09
3 H1L3	56.77	57.27	65.73	64.87	61.16	58.23	62.30	63.73	62.27	61.63
4 H3L4	55.10	56.90	62.67	61.37	59.01	55.73	56.33	61.33	59.83	58.31
Mean	58.05	60.33	67.48	65.34		60.13	61.85	65.73	64.62	
LSD at 5%	Genotypes (G)=1.69	Proline (P)=1.95	GxP= --			Genotypes (G)=1.53	Proline (P)=1.57	GxP= --		

Table 5. Means of pods weight plant-1(g) of soybean as affected by genotypes, proline concentrations, and their interaction in 2020 and 2021 seasons.

Genotypes (G)	Proline (P)									
	2020 season					2021 season				
	Control	25 ppm	50 ppm	75 ppm	Mean	Control	25 ppm	50 ppm	75 ppm	Mean
1 G 111	52.50	56.67	64.57	62.70	59.11	55.53	58.33	68.13	65.5	61.87
2H18L54	46.97	53.57	60.67	58.07	54.82	52.53	55.63	62.30	59.27	57.43
3 H1L3	43.80	51.10	55.27	52.53	50.68	48.63	51.57	57.50	54.17	52.97
4 H3L4	42.13	47.63	51.63	48.60	47.50	45.70	47.87	53.07	47.60	48.56
Mean	46.35	52.24	58.04	55.48		50.60	53.35	60.25	56.64	
LSD at 5%	Genotypes (G)=1.01	Proline (P)=1.43	GxP= 2.37			Genotypes (G)=1.37	Proline (P)=1.01	GxP= 1.98		

2-Seeds numberpod^{-1} and 100 seed weight traits:

The illustrated data in Tables 6 and 7 reveal that the seed number pod^{-1} and 100 seed weight traits of soybean were affected significantly by the studied factors in both seasons. Meanwhile, the interaction between proline concentrations and soybean genotypes were only significantly affected seeds number/ pods trait in both seasons. Proline added as foliar spray significantly improved seed number per pod and weight of 100 seed and the proclaimed increase was due to proline at the concentration of 50 ppm in both seasons. The lowest mean values of seed number/ pod and weight of 100 seeds were recorded with untreated soybean plants. Soybean genotypes affected markedly the two previous traits. However, the number of seeds per pod and weight of 100 seeds was the most proclaimed in the variety G111 compared to that in the other genotypes. Whereas, the lowest values of these parameters were recorded with the variety H3L4 in the two seasons. Concerning the interaction between proline rates and genotypes, the addition of 50 followed by 75 ppm of proline levels with G111 and H18L24 had the greatest increment in the seeds number/ pod and weight of 100 seeds in the 1st and 2nd seasons, respectively. Meanwhile, the lowest values were recorded with untreated genotype H3L4 in the two seasons. The results of Rady *et al.* (2016) were in accordance with our results. Also, Aini *et al.* (2012) revealed that the response of plants to stress depends on the genotype itself.

Table 6. Seeds number/ pod of soybean as affected by genotypes proline treatments and their interactions in 2020 and 2021 seasons.

Genotypes(G)	Proline (P)									
	2020 season					2021 season				
	Control	25 ppm	50 ppm	75 ppm	Mean	Control	25 ppm	50 ppm	75 ppm	Mean
1 G 111	3.43	3.77	4.33	3.90	3.86	3.23	3.40	4.43	3.80	3.72
2H18L54	2.70	3.13	3.23	3.07	3.03	2.90	3.23	2.90	2.80	2.96
3 H1L3	2.47	2.77	2.90	2.77	2.73	2.70	2.53	2.67	2.50	2.60
4 H3L4	2.33	2.53	2.53	2.53	2.48	2.50	2.77	2.60	2.47	2.59
Mean	2.73	3.05	3.25	3.07		2.83	2.98	3.15	2.89	
LSD at 5%	Genotypes (G)=0.16	Proline (P)=0.11	GxP= 0.22			Genotypes (G)=0.22	Proline (P)=0.18	GxP= 0.25		

Table7. Weight of 100 seeds (g) of soybean as affected by genotypes, proline treatments and their interactions in 2020 and 2021 seasons.

Genotypes(G)	Proline (P)									
	2020 season					2021 season				
	Control	25 ppm	50 ppm	75 ppm	Mean	Control	25 ppm	50 ppm	75 ppm	Mean
1 G 111	20.17	22.50	25.23	23.53	22.86	21.67	23.43	25.53	24.80	23.86
2H18L54	18.23	20.53	23.67	21.27	20.93	18.60	21.40	23.67	22.40	21.52
3 H1L3	16.87	19.03	21.57	20.23	19.43	17.13	19.90	21.93	20.20	19.79
4 H3L4	14.90	18.07	18.97	18.70	17.66	15.93	18.03	19.43	18.47	17.97
Mean	17.54	20.03	22.36	20.93		18.33	20.69	22.64	21.47	
LSD at 5%	Genotypes (G)=0.37	Proline (P)=0.38	GxP=--			Genotypes (G)=0.42	Proline (P)=0.98	GxP= --		

3-Seeds weight plant^{-1} and seeds yield plot^{-1} traits:

Data in Tables 8 and 9 show that the genotypes and proline concentrations caused a significant difference in seeds weight/ plant and seed yield/ plot of soybean in the two growing seasons. Also, the effect of interaction between proline concentrations and genotypes was significant on these parameters, except for the seed yield/ plot in the second season. The highest mean values of seeds weight/ plant and seed yield/ plot were recorded as a result of application proline at the rate of 50, followed by 75 ppm concentrations, respectively. Also, the control plants possessed the lowest averages, in the weight of seeds, compared with other studied proline concentrations as far as the effect of genotypes is concerned, the weight of seeds/plant and plot for G111 was greater than that of other varieties in both seasons. Meanwhile, the lowest values of the weight seeds per plant and plot resulted from the H3L4 genotype in both seasons compared to other genotypes. Concerning the effect of interaction between proline and genotypes, applied proline at the rate of 50 ppm with G111 gave the highest weight of the weight of seeds per plant and plot compared to other treatments. Meanwhile, the lowest ones resulted from the untreatedH3L4 line in both seasons. The simulated effects of proline on the growth and yield of different crops were noticed by several authors (Heikal and Shaddad, 1982; Hamed and Al-Wakeel, 1994 and Wahba *et al*., 2007). These results were in agreement with those of El-Sabagh *et al.* (2015), who notice that the G111soybean cultivar produced the highest number of seeds yield per plot than that of other cultivars.

Table 8. Seeds weight (g/plant) of soybean as affected by genotypes, proline treatments and their interactions in 2020 and 2021 seasons.

Genotypes(G)	Proline (P)									
	2020 season					2021 season				
	Control	25 ppm	50 ppm	75ppm	Mean	Control	25 ppm	50ppm	75ppm	Mean
1 G 111	31.17	38.43	44.67	40.07	38.59	32.80	36.50	44.57	39.37	38.31
2H18L54	28.57	36.03	38.17	36.27	34.76	30.77	34.27	39.43	36.40	35.22
3 H1L3	26.97	30.57	36.63	33.37	31.89	27.77	31.40	36.30	33.93	32.35
4 H3L4	24.47	26.63	32.90	30.60	28.65	25.30	29.17	34.13	30.73	29.83
Mean	27.80	32.92	38.09	35.08		29.16	32.84	38.61	35.11	
LSD at 5%	Genotypes (G)=0.59	Proline (P)=1.09	GxP=1.20			Genotypes (G)=0.56	Proline (P)=0.88	GxP= 1.28		

Table 9. Seeds yield (kg/ plot) of soybean as affected by genotypes, proline treatments and their interactions in 2020 and 2021 seasons.

Genotypes(G)	Proline (P)									
	2020 season					2021 season				
	Control	25 ppm	50 ppm	75 ppm	Mean	Control	25 ppm	50 ppm	75 ppm	Mean
1 G 111	1.58	1.83	2.00	1.81	1.81	1.48	1.68	1.99	1.81	1.74
2H18L54	1.38	1.54	1.71	1.62	1.56	1.37	1.51	1.71	1.69	1.57
3 H1L3	1.28	1.42	1.64	1.43	1.44	1.31	1.41	1.62	1.57	1.48
4 H3L4	1.25	1.36	1.49	1.36	1.37	1.26	1.37	1.54	1.47	1.41
Mean	1.37	1.54	1.71	1.56		1.36	1.49	1.72	1.64	
LSD at 5%	Genotypes (G)=0.03	Proline (P)=0.08	GxP=0.05			Genotypes (G)=0.03	Proline (P)=0.03	GxP= --		

4- Seed yield fed.$^{-1}$. (ton):

The effect of the genotypes, levels of proline, and interaction between them on the seed yield/ fed of soybean is shown in Table 10. The highest mean seed yield per fed. of 0.82 ton was observed with 50 ppm of proline treatment, followed by 75 ppm one with a mean yield of 0.75 and 0.79 ton in the 1st and 2nd seasons, respectively. The lowest mean value of 0.66 ton/ fed was observed with untreated plants. The highest means of yield per fed. of 0.87 and 0.84 tons were observed with var. G111 in the 1st and 2nd seasons, respectively. Meanwhile, the least mean values of 0.66 and 0.68 ton were observed with the variety H3L4 in the first and second seasons, respectively. Results of the interaction between genotypes and proline levels indicated a significant difference in yield/ fed which showed an increase, for 50 ppm proline concentration with the G111 genotype. The lowest mean value of 0.61 ton/ fed was observed with the untreated H3L4 line. Application of proline at different levels has been shown to stimulate the growth and yield of different crops (Hamed and Al-Wakeel, 1994 an Wahba *et al*., 2007).

Table 10. Seed yield/ feddan (ton) of soybean as affected by genotypes, proline treatments, and their interactions) in 2020 and 2021 seasons.

Genotypes(G)	Proline (P)									
	2020 season					2021 season				
	Control	25 ppm	50 ppm	75 ppm	Mean	Control	25 ppm	50 ppm	75 ppm	Mean
1 G 111	0.76	0.88	0.96	0.87	0.87	0.71	0.81	0.95	0.87	0.84
2H18L54	0.66	0.74	0.82	0.78	0.75	0.66	0.73	0.82	0.81	0.76
3 H1L3	0.62	0.68	0.79	0.69	0.70	0.63	0.68	0.78	0.75	0.71
4 H3L4	0.60	0.65	0.72	0.65	0.66	0.61	0.66	0.74	0.71	0.68
Mean	0.66	0.74	0.82	0.75		0.65	0.72	0.82	0.79	
LSD at 5%	Genotypes (G)=0.01	Proline (P)=0.03	GxP=0.04			Genotypes (G)=0.02	Proline (P)=0.03	GxP=0.02		

5-Harvest index (%):

Data illustrated in Table 11 reveal that the studied proline concentrations and soybean genotypes as well as their interaction had a significant effect on harvest index trait in the two growing seasons.

Thus, the highest mean values of harvest index of 42.71 and 42.02 were observed with proline at the rate of 50 ppm in the first and second seasons, respectively. The lowest mean values of 35.53 and 36.31 % were observed with untreated plants in 1st and 2nd seasons, respectively. Concerning the effect of genotypes on HI%, the highest means of 42.71 and 42.02 % were observed with cv. G111 in the 1st and 2nd seasons, respectively. Meanwhile, the lowest values of 37.36 and 38.03 % were observed with the H3L4 line in the first and second seasons, respectively. Results of the interaction between genotypes and proline levels indicated a significant difference in HI only in the 1st season which showed an increase, at the rate of 50 ppm level with G111 having the highest value. Meanwhile, the lowest values were observed with untreated H3L4 line in the 1st and 2nd seasons. These results are in good line with that obtained by Tilak *et al.* (2006).

Table 11. Harvest Index (%) of soybean as affected by genotypes, proline treatments, and their interactions in 2020 and 2021 seasons.

Genotypes(G)	Proline (P)									
	2020 season					2021 season				
	Control	25 ppm	50 ppm	75 ppm	Mean	Control	25 ppm	50 ppm	75 ppm	Mean
1 G 111	37.60	43.47	45.67	44.10	42.71	38.83	40.80	46.00	42.43	42.02
2H18L54	35.60	42.67	44.50	43.00	41.44	37.63	39.47	44.43	42.20	40.93
3 H1L3	35.23	38.93	43.20	41.80	39.79	35.30	37.77	42.37	40.80	39.06
4 H3L4	33.67	34.90	41.03	39.83	37.36	33.47	36.87	41.47	40.30	38.03
Mean	35.53	39.99	43.60	42.18		36.31	38.73	43.57	41.43	
LSD at 5%	Genotypes (G)=0.75	Proline (P)=1.29	GxP=1.55			Genotypes (G)=0.49	Proline (P)=1.48	GxP=--		

6-Protein content (%):

The effect of the genotypes, varying levels of proline, and the interaction between them on the protein content of soybean seeds is shown in Table 12. Exogenous application of proline levels caused increases in protein % compared with the untreated plants. The highest mean protein percentages of 39.14 and 39.07 were observed in the 50 ppm of proline treatment in the first and second seasons, respectively. The lowest mean values of 37.83 and 37.82 % were observed with untreated plants in 1st and 2nd seasons, respectively. Effect of the varying genotypes of soybean on the protein content of soybean seeds pointed out that the highest means of 39.21 and 39.18% were observed with cv. G111 in the 1st and 2nd seasons, respectively. Meanwhile, the least mean values of 37.81 and 37.75 % were observed with the H1L3 line in the first and second seasons, respectively. Results of the interaction between genotypes and proline rates indicated a significant difference in protein content which showed an increase, at the rate of 50 ppm level with G111 having the highest value. The least mean values of 37.19 and 37.08% were observed with untreated H1L3 line in the 1st and 2nd seasons, respectively. A similar trend was observed by Krisnawati and Adie (2017).

Table 12. Protein content (%) in seeds of soybean as affected by genotypes), proline treatments and their interactions in 2020 and 2021 seasons.

Genotypes(G)	Proline (P)									
	2020 season					2021 season				
	Control	25 ppm	50 ppm	75 ppm	Mean	Control	25 ppm	50 ppm	75 ppm	Mean
1 G 111	38.37	38.78	40.20	39.49	39.21	38.33	38.85	40.14	39.38	39.18
2H18L54	37.37	37.65	38.57	38.19	37.95	37.22	37.71	38.54	38.39	37.97
3 H1L3	37.19	37.63	38.3	38.11	37.81	37.08	37.33	38.38	38.20	37.75
4 H3L4	38.40	38.58	39.49	38.36	38.71	38.65	38.84	39.23	38.41	38.78
Mean	37.83	38.16	39.14	38.54		37.82	38.18	39.07	38.60	
LSD at 5%	Genotypes (G)=0.21	Proline (P)=0.12	GxP=0.31			Genotypes (G)=0.12	Proline (P)=0.10	GxP=0.21		

7-Oil content (%):

The effect of soybean genotypes, levels of proline, and the interaction between them on the oil content of seeds is shown in Table 13. Thus, the highest mean oil percentages of 21.96 and 21.84 were observed with the rate of 50 ppm of proline in the first and second seasons, respectively. The lowest mean values of 19.46 and 19.53% were observed with untreated plants in 1st and 2nd seasons, respectively. Effect of genotypes on the oil content of seeds showed that the highest means of 21.98 and 22.17% were observed with cv. G111 in the 1st and 2nd seasons, respectively. Meanwhile, the lowest values of 20.37 and 20.30% were observed with the H3L4 line in the first and second seasons, respectively. Results of the interaction between genotypes and proline levels indicated a significant difference in oil content which showed an increase, at the rate of 50 ppm level with G111 having the highest value. The lowest values of 19.72 and 19.67% were observed with untreated var. H3L4 in the 1st and 2nd seasons, respectively. These results were in agreement with those obtained by El-Sabagh *et al.* (2015) and Krisnawati and Adie (2017).

Table 13. Oil content (%) in seeds of soybean as affected by genotypes, proline treatments, and their interactions in 2020 and 2021 seasons.

Genotypes(G)	Proline (P)									
	2020 season					2021 season				
	Control	**25 ppm**	**50 ppm**	**75 ppm**	**Mean**	**Control**	**25 ppm**	**50 ppm**	**75 ppm**	**Mean**
1 G 111	19.92	21.79	23.78	22.43	21.98	20.34	21.75	23.78	22.81	22.17
2H18L54	19.61	20.60	21.76	21.47	20.86	19.49	20.49	21.56	21.59	20.78
3 H1L3	18.60	20.77	21.60	21.53	20.63	18.60	20.68	21.43	21.28	20.50
4 H3L4	19.72	20.56	20.68	20.50	20.37	19.67	20.52	20.60	20.42	20.30
Mean	19.46	20.93	21.96	21.48		19.53	20.86	21.84	21.53	
LSD at 5%	Genotypes (G)=0.23	Proline (P)=0.22	GxP=0.33			Genotypes (G)=0.16	Proline (P)=0.25	GxP=0.36		

Conclusion

According to our results, it can be concluded that:

1.The number of pods/ plant, number of seeds/ pod, seed weight/ plant, pods weight/ plant, the weight of 100 seeds, seeds weight/ plot, seeds weight/fed, and harvest index, that are the elements determining the level of soybean seed yields, are significantly dependent on the use of proline levels.

2.In practice, in order to achieve an increase in soybean seed yield it is recommended to apply soybean plants with proline at the rate of 50 or 75 ppm.

3.The results from our study show that exogenous proline could lead to greater soybean productivity in this newly reclaimed soil of the Upper Egypt region.

4.Giza 111 and H18L54 genotypes may be suitable for this area and at the same treatments. However, further studies involving different proline rates, cultivars, other plant stimulators, growing seasons, and multiple sites in Upper Egypt need to be undertaken before definite recommendations can be made.

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تأثير اضافة البرولين علي المحصول ومكوناته لبعض التراكيب الوراثية لفول الصويا تحت ظروف الأراضي حديثة الاستصلاح

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الملخص

أجريت هذه الدراسة خلال موسمي ٢٠٢٠و٢٠٢١ بمحطة البحوث الزراعية بالمراشدة – قنا – مركز البحوث الزراعية – مصر بأراضي حديثة الاستصلاح منخفضة في العناصر الغذائية و المادة العضوية ذات محتوى عالي من الملوحة، أيضا كان محتوى الملوحة بمياه الري مرتفعا وتهدف الدراسة لتقييم المحصول ومكوناته لأربع تراكيب وراثية من فول الصويا تحت تأثير استخدام اربع مستويات من البرولين. تم استخدام أربع تراكيب وراثية هى جيزة ١١١و H18L54 وH1L3 وH3L4 مع أربع تركيزات من البرولين و هي صفر و ٠.٢٥ و ٠.٥٠ و٠.٧٥ جزء في المليون وصممت التجربة بنظام الشرائح المنشقة بثلاث مكررات حيث تم توزيع معاملات الرش بالبرولين افقيا والتراكيب الوراثية راسيا.

وكانت أهم النتائج كما يلي:

نتج أعلى القيم الخاصة بالمحصول ومكوناته عند استخدام صنف جيزة ١١١ يليه السلالة H18L54 فى الموسمين الأول و الثانى.

كان للتفاعل بين مستويات البرولين والتراكيب الوراثية لفول الصويا تأثيرا في زيادة المحصول ومكوناته للأصناف تحت الدراسة.

لوحظ أن الرش الورقى للبرولين عند مستوى ٥٠ يليه ٧٥جزء فى المليون مع صنف جيزة ١١١ والسلالة H18L54 أدى الى الحصول علي أعلى القيم الخاصة بالمحصول ونسبة البروتين والزيت في البذرة لكلا الموسمين على التوالى مقارنة بباقى المعاملات.

وعليه توصي الدراسة بزراعة صنف فول الصويا جيزة ١١١ ورشه ورقيا بالبرولين بتركيز ٥٠ جزء فى المليون ثلاث مرات عند عمر ٢٠ ، ٣٥ و ٥٠ يوم من الزراعة للحصول على أعلى عائد من محصول البذور وكذلك محتواها من الزيت والبروتين تحت الظروف المشابهة لظروف البحث .