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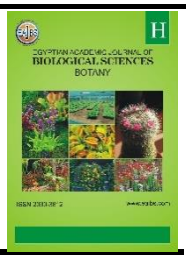

The Response of Some Egyptian and Iraqi Soybean Varieties to Salicylic Acid Under Salinity Soil Conditions

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ABSTRACT

The present study was carried out at Nubaria, El-Beheira Governorate, Egypt, during the two summer seasons of 2018 and 2019 to study the effect of foilar application of salicylic rates on yield and quality of some soybean varieties under drip irrigation. This experiment was laid out in a split-plot system with three replications in both seasons. The main plots were soybean varieties (Giza111, Giza 22, J350, and J356), while subplot allocated by the number of spray times of salicylic acid (SA) concentration (water = control, once after 30 DAS, twice after 30, and 50 DAS, and three times after 30, 50 and 70 days after sowing=DAS) was in both seasons. The obtained results showed that foliar application of salicylic acid (SA) of the four soybean varieties significantly affected plant height (cm), number of branches/plant, number of pods/plant, 100- seed weight (g), seed yield (kg/fed), straw yield (kg/fed), biological yield (kg/fed), as well as oil content (%), whereas Giza 111 recorded the highest values of the all the study, also increasing of times of foliar application of SA increased the pervious characters comparing with the control treatments (water spray) in both seasons. The interaction between varieties and number of spray times of SA was significant on all the studied characters, where planting Giza 111 with twice foliar application of SA at the rate 1000 ppm recorded the highest ones in the two cropping seasons in drip water irrigation under the study conditions.

INTRODUCTION

Soybean (*Glycine max* L.) is widely cultivated for its edible bean, which has many uses. Soybean is the cheap and most important protein source for animal feed and human food. Among the legumes, soybean is valued for its high protein content (38–45%) , also soybean seed contains 18–19% oil (Livestock's long shadow, 2016). Soybean is a globally important crop that provides protein and oil for a wide array of products. By weight, soybean seed is made up of roughly 40% protein, 20% oil, 35% carbohydrate, and 5% ash (Soares *et al*., 2008). The total cultivated area of soybean in the world in 2017 was about 123.5 million ha produced about 352.64 million tons, while in Egypt, the cultivated area was about 15000 ha produced approximately 45000 tons from dry seeds (FAO, 2018).

Soybean is a very sensitive plant to drought and salinity conditions during vegetative and reproductive growth. Since soybean is classified as dehydration-sensitive

species that require optimum water quantity in the seed germination phase. Seed growth and plant growth (Chen *et al*., 2006). Salt stress impacts major plant processes as photosynthesis, protein synthesis, and lipid metabolism (Parvaiz and Satyawati, 2008).

Salinity is an obstacle in agriculture, and the ability to maintain or even increase soybean production rates under this constraint will require a good understanding of the genetic components responsible for salt tolerance in the soybean. Salt stress negatively affects of germination and growth of soybean plants, but this abiotic stress can also cause a reduction in the agronomic quality of beans harvested from salt-stressed soybean. Protein (%) of soybean seeds is decreased under salt stress although effects on oil content are inconclusive (Chang *et al*., 1994). In addition, salinity decreased the overall productivity of soybean, also decreased the number and biomass of root nodules and the efficiency of nitrogen fixation (Singleton and Bohlool, 1984; Delgado *et al*., 1994). Salicylic acid is an endogenous growth regulator of phenolic nature, which participates in the regulation of physiological processes in plants. Salicylic acid plays an important role in the defense response to abiotic stresses in many species of plants (Pasala *et al*., 2016). Salicylic acid enhances plant growth and photosynthetic capacity in saline conditions (Noreen *et al*., 2012). Treatment of Salicylic acid, also significantly increases dry weights of root and top part under saline conditions (Gutierrez-Coronado *et al.*, 1998; Stevens *et al*., 2006). On the other hand, Khodary (2004) found that salicylic acid could induce salt tolerance in maize plants via accelerating their photosynthesis performance and carbohydrate metabolism.

The aims of this study were to:

Study the response of the four soybeans to salicylic acid (SA), and the interaction effect between soybean varieties and salicylic acid (SA) concentrations on yield and its components of soybean to determine the best variety with salicylic acid (SA), which will increase the production and quality of seeds and avoid exposure of the crop to salt stress.

MATERIALS AND METHODS

Two field experiments were conducted out at Nubaria, El- Behira Governorate, Egypt, during the two summer seasons of 2019 and 2020 to study the effect of foliar application of salicylic acid (SA) times to reduce the salt stress effect in the soybean cultivars i.e. Giza 111, Giza 22, J350 and J356 under drip irrigation using yield measurement to determine the optimal variety and the best date of salicylic acid application could be used to maximized seed yield and seed quality under salt stress conditions.

The physical and chemical properties of experimental soil are presented in Table 1 which according to the method described by Page *et al.* (1982).

This experiment was laid out in a split plot system in three replications in both seasons. The main plots were soybean varieties (Giza111, Giza 22, J350, and J356), while the number of spray times of salicylic acid (SA) concentration (water = control, once after 30 DAS, twice after 30, and 50 DAS, and three times after 30, 50 and 70 days after sowing (DAS)) at the rates of 1000 ppm was in both seasons.

In both seasons of 2019 and 2020 soybean seeds were sown in 5th and 1st April in 2019 and 2020 seasons, respectively.

Each subplot included 5 lines. Each line was 3.5 meters long and 70 cm apart. Seeds were sown on two sides of the irrigation line at 20 cm hill apart with two seed per hill. The dry planting method called (Affier) and the rates of seeds were 40 kg seeds/fed.

The commercial silicon from El Jomhoureya Company – Cairo- Egypt was prepared in a concentration of 1000 ppm and sprayed during the growing season according to the above treatments.

NPK (50 kg N/fed, 24 P_2O_5/fed, and 24 K_2O) were splatted and applied with irrigation water and all the other cultural practices were done according to the

recommendation of the Ministry of Agriculture and Land Reclamation recommendations in The Nubaria Region.

Table 1. Physiochemical properties of experimental soil in both seasons

Properties	Seasons	
	2019	2020
Particle size distribution (%)		
Clay	7.50	7.60
Slit	2.00	2.00
Sand	90.50	90.40
Textural class	Sandy	
$CaCO_3$	3.15	2.45
Organic matter (OM %)	0.89	0.90
pH	7.90	7.85
EC (dS/m)	3.93	3.88
Soluble cations (meq/L)		
Ca++	22.12	21.10
Mg++	3.84	3.61
K+	0.56	0.64
Na+	12.17	12.89
Soluble Anions (meq/L)		
Cl-	11.11	11.42
HCO_3^-	2.85	2.70
SO_4^-	25.80	25.02
Available nutrient (mg/kg)		
K+	112.10	118.34
P	22.00	21.34
N	41.78	40.09
Fe	5.62	5.45
Zn	3.30	3.50
Mn	3.60	3.45
Cu	1.60	1.55

At harvest time, plant height (cm), number of branches/plant, number of pods/plant, 100- seed weight (g) , seed yield (kg/fed), straw yield (kg/fed), biological yield (kg/fed), harvest index (%), and seed oil content (%) were recorded in both seasons, where oil % was determined using soxcelt apparatus using n-hexan, according to AOAC (1995).

Table 2. Water irrigation analysis of experimental sites in both seasons

Properties	Seasons	
	2019	2020
P^H	7.30	7.50
EC (dS/m)	3.36	3.38
Soluble cations (meq/L)		
Ca++	8.50	8.10
Mg++	6.00	5.61
K+	0.36	0.34
Na+	18.50	17.89
$CaCO_3$	0.00	0.00
Soluble Anions (meq/L)		
Cl-	14.63	13.42
HCO_3^{--}	3.85	3.70
SO_4^{--}	14.80	15.02
Available nutrient (mg/l)		
K+	14.10	13.34
Fe	0.20	0.25
Zn	0.01	0.02
Mn	0.35	0.45
Cu	0.01	0.02

All collected data were subjected to analysis of variance according to Gomez and Gomez (1984). All statistical analysis was performed using analysis of variance technique by means of CoStat (2005) computer softwere package.

RESULTS AND DISCUSSION

The results in Table (3) reported that plant height (cm), number of branches/plant, number of pods/plant, and 100- seed weight (g) of four soybean varieties were significantly affected by foliar application of salicylic acid (SA) times during 2019 and 2020 seasons.

Results in Table (3) revealed that soybean varieties significantly differed in plant height (cm), number of branches/plant, number of pods/plant, and 100- seed weight (g) in both seasons, where Giza 22 variety recorded the longest plant height (cm), and the highest number of branches/plant, number of pods/plant, and 100- seed weight (g) comparing with the other varieties. While, the lowest mean values of plant height (cm), number of branches/plant, number of pods/plant, and 100- seed weight (g) were given with J350 variety in both seasons. The difference may be attributed to soybean varieties due to genetics characters. These findings are in harmony with those obtained by Sadeghi and Niyaki (2013); Naoki *et al.* (2016); Hasanah and Sembiring (2018) they stated that soybean varieties differed in growth and yield characters.

Table (3) showed that by increasing number of times of SA application increased plant height (cm), number of pods/plant, 100- seed weight (g) and number of branches/plant in both seasons, where the highest mean values of plant height (cm), number of pods/plant, 100- seed weight (g) recorded with foliar application of SA at the rate of 1500 ppm followed by 1000 ppm from SA which had no significant difference between its concentrations, while the lowest values of plant height (cm), number of pods/plant, 100- seed weight (g) of soybean were given with spray water (control) treatment in the two seasons. These findings are in agreement with those obtained by Khodary (2004); Stevens *et al*. (2006); Noreen *et al*. (2012), they revealed the vital role of application of salicylic acid on growth and yield characters.

Table 3. Plant height (cm), number of branches/plant, number of pods/plant, and 100- seed weight (g) of four soybean varieties as affected by salicylic acid (SA), and their interaction in both seasons

Treatment	Plant height		Number of branches/plants		Number of pods/plants		100- seed weight	
	2019	2020	2019	2020	2019	2020	2019	2020
A- Soybean varieties								
Giza111	100.4	103.7	4.8	5.3	33.3	33.6	14.9	13.5
Giza 22	106.9	107.2	3.7	4.6	30.3	33.3	13.8	12.5
J350	68.3	74.1	3.5	4.2	27.3	30.3	12.8	11.7
J356	78.6	76.7	3.5	4.7	22.4	25.0	11.9	10.5
$LSD_{0.05\ (A)}$	9.3	8.4	0.6	0.5	0.8	2.5	0.8	0.7
B- Salicylic acid (SA) spray times								
Water	86.8	87.3	3.2	3.7	18.6	20.7	11.6	10.4
Once	87.9	91.1	3.9	4.8	31.7	34.1	13.0	11.5
Twice	84.3	87.6	3.9	5.3	28.8	31.8	14.1	12.6
Three Times	94.6	95.6	4.4	5.5	34.1	35.6	14.7	13.8
$LSD_{0.05\ (B)}$	ns	ns	0.5	0.6	2.7	2.6	1.0	0.9
Interaction								
A x B	*	*	*	*	*	*	*	*

* and ns: significant and not significant difference at 0.05 level of probability.

The interaction between soybean varieties and salicylic acid (SA) had significant on plant height (cm), where planting Giza 22 variety with foliar application of SA/fed three times at the rate of 1000 ppm recorded the longest plant height (cm), however fertilizing Giza 111 variety by three times of SA/fed or twice recorded the highest number of branches/plant, number of pods/plant, and 100- seed weight (g), while the lowest value recorded with Iraqi varieties as comparing with Egyptian varieties in the two growing seasons (Table 4).

Table 4. Interaction effect between soybean varieties and salicylic acid (SA) of plant height (cm), number of branches/plant, number of pods/plant, and 100- seed weight (g) in both seasons.

Treatments		Plant height		Number of branches/plants		Number of pods/plants		100- seed weight	
Soybean varieties	SA spray times	2019	2020	2019	2020	2019	2020	2019	2020
Giza111	Water	91.0	92.3	3.3	3.3	23.3	23.0	13.0	11.9
	Once	100.7	104.7	4.7	6.3	36.2	36.8	14.9	13.3
	Twice	108.0	112.0	5.7	7.0	33.3	36.3	15.3	13.8
	Three Times	101.7	105.7	5.3	4.7	40.3	38.3	16.2	15.0
Giza 22	Water	100.3	104.3	4.0	4.0	20.3	23.3	11.8	10.6
	Once	115.0	111.0	3.0	5.0	33.2	36.2	13.4	11.9
	Twice	93.3	94.3	3.3	4.3	30.3	33.3	14.5	12.9
	Three Times	117.0	119.0	4.3	5.0	37.3	40.3	15.5	14.6
J350	Water	77.7	84.0	2.3	3.3	17.3	20.3	11.1	9.5
	Once	67.0	76.0	4.3	4.0	30.2	33.2	12.2	10.8
	Twice	64.7	68.7	3.0	4.3	27.3	30.3	13.7	12.1
	Three Times	63.7	67.7	4.3	5.0	34.3	37.3	14.2	14.2
J356	Water	78.3	68.7	3.0	4.0	13.3	16.0	10.3	9.4
	Once	68.7	72.7	3.7	3.7	27.2	30.2	11.5	9.9
	Twice	71.3	75.3	3.7	5.7	24.3	27.3	12.9	11.4
	Three Times	96.0	90.0	3.7	5.5	24.6	26.3	13.0	11.3
$LSD_{0.05\ (A\ x\ B)}$		27.3	26.2	1.3	1.4	5.3	5.9	2.1	1.9

The results in Table (5) revealed that seed yield (kg/fed), straw yield (kg/fed), biological yield (kg/fed), harvest index (%), and seed oil content (%) of four soybean varieties were significantly affected by foliar application of salicylic acid (SA) during 2019 and 2020 seasons.

Table (5) reported that soybean varieties significantly differed in seed yield (kg/fed), straw yield (kg/fed), biological yield (kg/fed), and seed oil content (%) except harvest index (%), during both seasons, where Giza 22 variety recorded the highest mean values of these traits comparing with the other varieties. While the lowest ones were given with J350 variety in the first and second seasons. The difference may be attributed to soybean varieties due to genetics characters. These findings are in agreement with those obtained by Sadeghi and Niyaki (2013); Naoki *et al.* (2016); Hasanah and Sembiring (2018) they stated that soybean varieties differed in yield characters.

Result in Table (5) revealed that by using foliar application of SA twice spray at 30 and 50 DAS increased seed yield (kg/fed), straw yield (kg/fed), biological yield (kg/fed), as well as seed oil content in both seasons except harvest index (%) in both seasons, Meanwhile, the lowest one were given with spray water (control) treatment during the two seasons. Salicylic acid has a regulatory role in plant physiology include inhibiting ethylene biosynthesis, interfering with membrane depolarization, blocking wound responses, and an increase in photosynthetic rate and chlorophyll content in soybean (Raskin, 1992). It quiet ardent from the present result that SA has a vital role in soybean growth expressed in terms of the plant under salinity conditions. This vital role of SA and its necessity for protoplasm formation, photosynthesis activity, cell division, and meristem activity in plant organs is clearly illustrated. These findings are in agreement with those obtained by Stevens *et al*. (2006); Khodary (2004); Noreen *et al*. (2012); Pasala *et al*. (2016) they showed the vital role of application of salicylic acid on yield and its components characters.

The interaction between soybean varieties and salicylic acid (SA) was significant on these traits, In this respect, the results in Table (6) revealed that the highest mean values of seed yield (kg/fed), straw yield (kg/fed), biological yield (kg/fed), as well as seed oil content (%) of soybean. Planting Giza 111 + foliar application of SA twice achieved the highest values of the most previous especially seed yield and oil (%), meanwhile, the lowest ones were recorded with the control treatments (spray water) + J350 variety in both seasons**.**

Table 5. Seed yield (kg/fed), straw yield (kg/fed), biological yield (kg/fed), harvest index (%), and seed oil content (%) of four soybean varieties as affected by salicylic acid (SA), and their interaction in both seasons.

Treatment	Seed yield		Straw yield		Biological yield		Harvest index		Seed oil content	
	Seasons									
	2019	2020	2019	2020	2019	2020	2019	2020	2019	2020
A- Soybean varieties										
Giza111	902.9	772.1	1093.9	1067.8	1996.7	1839.9	45.0	41.6	21.8	21.8
Giza 22	720.2	612.9	868.1	886.4	1588.3	1499.3	45.1	40.9	20.9	22.1
J350	583.4	508.7	648.8	674.6	1232.2	1183.2	46.7	42.7	20.3	20.7
J356	638.2	617.8	713.4	881.8	1351.5	1499.6	47.4	41.2	18.7	19.6
$LSD_{0.05\ (A)}$	82.5	92.3	142.2	101.7	209.3	166.6	ns	ns	0.5	1.5
B- SA spray times										
Water	498.6	472.4	669.2	699.7	1167.805	1172.16	42.8	40.3	17.6	18.7
Once	787.3	691.6	905.0	953.6	1692.298	1645.193	46.8	41.9	21.1	22.1
Twice	875.9	743.6	959.0	997.3	1834.953	1740.885	48.2	42.7	21.3	22.1
Three Times	682.8	603.9	790.9	859.9	1473.683	1463.845	46.5	41.5	21.2	21.3
$LSD_{0.05\ (B)}$	151.3	136.9	191.3	108.4	324.3	230.3	4.0	ns	1.5	1.3
A x B	*	*	*	*	*	*	*	*	*	*

ns ; *: not significant and significant difference at 0.05 level of probability

Table 6. Interaction effect between soybean varieties and salicylic acid (SA) of seed yield (kg/fed), straw yield (kg/fed), biological yield (kg/fed), harvest index (%), and seed oil content (%) in both seasons

Treatments		Seed yield (kg/fed)		Straw yield (kg/fed)		Biological yield (kg/fed)		Harvest index (%)		Seed oil content (%)	
Soybean varieties	Salicylic acid (SA) ppm	2019	2020	2019	2020	2019	2020	2019	2020	2019	2020
Giza111	Water	573.6	541.0	766.4	803.9	1340.0	1344.9	42.8	40.2	18.3	18.2
	Once	1088.2	911.3	1290.8	1172.8	2379.0	2084.1	45.7	43.7	22.7	23.7
	Twice	1150.8	973.7	1379.6	1248.1	2530.4	2221.8	45.5	43.8	23.3	23.7
	Three Times	799.0	662.6	938.7	1046.2	1737.7	1708.8	46.0	38.8	23.0	21.5
Giza 22	Water	477.6	440.4	623.7	644.0	1101.3	1084.4	43.4	40.6	17.8	19.3
	Once	902.6	710.6	1006.6	1026.5	1909.2	1737.1	47.3	40.9	22.1	23.7
	Twice	769.4	658.8	933.1	945.9	1702.6	1604.7	45.2	41.1	21.5	22.8
	Three Times	731.0	641.8	909.0	929.4	1640.0	1571.2	44.6	40.8	22.0	22.6
J350	Water	320.6	302.6	428.7	450.2	749.4	752.8	42.8	40.2	17.3	18.8
	Once	772.6	635.8	760.9	781.7	1533.5	1417.4	50.4	44.9	21.6	20.5
	Twice	639.4	561.4	737.3	773.7	1376.7	1335.0	46.4	42.0	20.9	21.5
	Three Times	601.0	535.0	668.3	692.8	1269.2	1227.7	47.3	43.6	21.4	21.9
J356	Water	622.6	605.8	858.0	900.8	1480.6	1506.6	42.0	40.2	16.9	18.3
	Once	677.8	654.2	689.0	933.0	1366.8	1587.2	49.6	41.2	18.8	20.3
	Twice	652.1	635.0	658.9	921.9	1311.0	1557.0	49.7	40.8	20.6	20.5
	Three Times	600.2	576.2	647.5	771.5	1247.8	1347.7	48.1	42.8	18.5	19.1
$LSD_{0.05\ (A\ x\ B)}$		302.5	273.5	382.4	216.6	648.6	460.5	5.0	3.5	3.0	2.7

CONCLUSION:

As a result of these two growing seasons field's study, it was concluded that yield, its components of soybean crop increased with planting date soybean cv. Giza 111 with foliar application of salicylic acid (SA) twice at 30 and 50 days after sowing (DAS) at the rate of 1000

ppm, on the other hand, spray SA the three times recorded the highest values of some the studied character in drip irrigation system under study conditions at Nubaria, El- Behira Governorate, Egypt.

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ARABIC SUMMARY

إستجابة بعض أصناف فول الصويا المصرية والعراقية لحامض السالسيلك تحت ظروف الملوحة

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فول الصويا يتبع العائلة البقولية وهو من المحاصيل الغذائية والصناعية الهامة على المستوى المحلي والعالمي.ويزرع للحصول على البذور لاستخدامها في استخراج الزيت الذي يستخدم في الطعام كما أنه يدخل في مجموعة من الأغذية والأدوية.ويتميّز عن بقية الأنواع الأخرى مع البقول بأنه يحتوي على جميع الأحماض الأمينية الأساسية الضرورية لجسم الإنسان. ونظراً لوجود فجوة غذائية في المحاصيل الزيتية ودور الدولة في تقليل هذه الفجوة والتوسع في هذه المحاصيل وذلك بزراعته في الأراضي الجديدة والعمل على زيادة الانتاجية بالتوسع الرأسي فأجريت هذه الدراسة فى مزرعة بمنطقة النوبارية – محافظة البحيرة خلال الموسم الصيفى لعامى 2019 و 2020 و ذلك لدراسة تأثير عدد مرات الرش من حامض السالسيلك على بعض أصناف فول الصويا المصرية والعراقية تحت ظروف ملوحة مياه الري تحت نظام الري بالتنقيط. ووزعت المعاملات عشوائياً تصميم تجريبى هو القطع المنشقة مرة واحدةSplit plot design فى ثلاث مكررات مع التوزيع العشوائى للمعاملات التجريبية وهى:

أ- القطع الرئيسية: 4 أصناف من فول الصويا (المصرية والعراقية) : الأصناف المصرية : جيزة 111 و جيزة 22 والأصناف العراقية : جى350 وجى 356.

ب- القطع تحت الرئيسية : مرات الرش بحمض السالسيليك:

1- الرش بالماء (معاملة المقارنة).
2- الرش مرة واحدة (بعد 30 يوم من الزراعة).
3- الرش مرتين (بعد 30 ، 50 يوم من الزراعة).
4- الرش الورقي ثلاثة مرات (بعد 30 ، 50 ، 70 يوم من الزراعة).

المعاملات الزراعية الأخري أجريت كتوصيات وزراة الزراعة واستصلاح الأراضي لمحصول فول الصويا.

وأظهرت النتائج أنه:

- يوجد اختلاف بين الأربع أصناف من الفول الصويا معنوياً في جميع الصفات المدروسة مثل ارتفاع النبات (سم) وعدد الأفرع للنبات وعدد القرون للنبات ووزن 100 بذرة (جم) ومحصول البذور (كجم/فدان) ومحصول العرش (كجم/فدان) والمحصول البيولوجي ودليل الحصاد (%) ومحتوى البذور من الزيت (%) تحت ظروف مياه الري الملحية باستخدام نظام الري بالتنقيط خلال موسمي الزراعة.
- تفوق صنف جيزة 111 عن باقي أصناف فول الصويا في جميع الصفات المدروسة حيث حقق أعلى قيم لهذه الصفات مقارنة بباقي الأصناف الأخرى المصرية والعراقية.
- أثر الرش الورقي بحمض السالسيلك تأثيراً معنوياً على كل من ارتفاع النبات (سم) وعدد الأفرع للنبات وعدد القرون للنبات ووزن 100 بذرة (جم) و محصول البذور (كجم/فدان) ومحصول العرش (كجم/فدان) والمحصول البيولوجي ودليل الحصاد (%) و محتوى البذور من الزيت (%) تحت ظروف مياه الري الملحية باستخدام نظام الري بالتنقيط خلال موسمي الزراعة.
- زيادة عدد مرات الرش الورقي لحامض السالسيلك حققت زيادة معنوية في معظم الصفات المدروسة تحت ظروف التجربة. وسجل الرش مرتين عند 30 و 50 يوم من الزراعة اعلى متوسط قيم للصفات تحت الدراسة ومتبوعاً بمعدل بالرش ثلاثة مرات في حين أن الرش بالماء (معاملة الكنترول) سجلت أعلى القيم للصفات المدروسة خلال موسمي الدراسة
- التداخل بين عاملي الدراسة كان له تأثير معنوياً حيث وجد أن الرش الورقي لحامض السالسليك مرتين أو ثلاثة مرات وبمعدل 1000 جزء في المليون لصنف جيزة 111 المصري حيث حققت هذه التوليفة أعلى القيم لجميع صفات الدراسة خلال موسمي الزراعة.

التوصية:

من النتائج السابقة يوصى البحث بزراعة صنف فول الصويا المصري (جيزة 111) مع الرش الورقي مرتين أو ثلاثة مرات وبمعدل 1000 جزء في المليون من حامضي السالسليك حيث أن ذلك حقق أعلى محصول بذور ومكوناته وأعلى نسبة زيت في البذور (%) تحت ظروف مياه الري الملحية خلال نظام الري بالتنقيط وخلال موسمي الدراسة وتحت ظروف منطقة النوبارية – محافظة البحيرة – مصر وظروف المناطق المماثلة لها.