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

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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 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 P₂O₅/fed, and 24 K₂O) 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                          | 2019  | 2020  |
|-------------------------------------|-------|-------|
| **Particle size distribution (%)**  |       |       |
| Clay                                | 7.50  | 7.60  |
| Silt                                | 2.00  | 2.00  |
| Sand                                | 90.50 | 90.40 |
| Textural class                      | Sandy |       |
| CaCO₃                               | 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 |
| HCO₃⁻                               | 2.85  | 2.70  |
| SO₄²⁻                               | 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    |
| **pH**                     | 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   |
| **CaCO3**                   | 0.00    | 0.00    |
| Soluble Anions (meq/L)      |         |
| **Cl**-                     | 14.63   | 13.42   |
| **HCO3**-                   | 3.85    | 3.70    |
| **SO4**-                    | 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 software 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 2019 | Plant height 2020 | Number of branches/plants 2019 | Number of branches/plants 2020 | Number of pods/plant 2019 | Number of pods/plant 2020 | 100-seed weight 2019 | 100-seed weight 2020 |
|-----------------|-------------------|-------------------|-------------------------------|-------------------------------|---------------------------|---------------------------|---------------------|---------------------|
| 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**

| Treatment       | Plant height | Number of branches/plants | Number of pods/plant | 100-seed weight |
|-----------------|--------------|----------------------------|----------------------|-----------------|
| Water           | 86.8         | 3.2                        | 3.7                  | 18.6            | 20.7            | 11.6            | 10.4            |
| Once            | 87.9         | 3.9                        | 4.8                  | 31.7            | 34.1            | 13.0            | 11.5            |
| Twice           | 84.3         | 3.9                        | 5.3                  | 28.8            | 31.8            | 14.1            | 12.6            |
| Three times     | 94.6         | 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.

| Soybean varieties | Treatments | Plant height | Number of branches/plant | Number of pods/plants | 100- seed weight |
|-------------------|------------|--------------|--------------------------|-----------------------|-----------------|
|                   | 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 |

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 |
|-----------|------------|-------------|------------------|---------------|-----------------|
|           | 2019 | 2020 | 2019 | 2020 | 2019 | 2020 | 2019 | 2020 | 2019 | 2020 | 2019 | 2020 |
| Giza 111  | 902.0 | 772.1 | 1093.9 | 1057.8 | 1090.7 | 1839.0 | 45.6 | 41.6 | 21.8 | 21.8 |
| Giza 22   | 720.2 | 612.9 | 868.1 | 884.6 | 1388.3 | 1499.3 | 45.1 | 49.9 | 26.9 | 22.1 |
| J350      | 584.3 | 509.7 | 648.8 | 674.6 | 1232.2 | 1183.2 | 46.7 | 42.7 | 26.3 | 20.7 |
| J356      | 638.2 | 617.8 | 713.4 | 681.8 | 1351.5 | 1490.6 | 47.4 | 41.2 | 18.7 | 19.0 |
| LSD0.05(A×B) | 82.5 | 92.3 | 142.2 | 101.7 | 209.3 | 106.6 | 0.5 | 1.5 |

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

| Treatment | Seed yield (kg/fed) | Straw yield (kg/fed) | Biological yield (kg/fed) | Harvest index (%) | Seed oil content (%) |
|-----------|-------------------|-------------------|-------------------|-----------------|-------------------|
| Giza111   |                   |                   |                   |                 |                   |
| Water     | 573.6             | 541.0             | 766.6             | 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           | 1706.0           | 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     | 639.3             | 561.4             | 737.3             | 773.7           | 1576.7           | 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             | 605.6             | 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 |
| LSD0.05(A×B) | 302.5            | 273.5             | 382.4             | 216.6           | 648.6            | 460.5            | 30.0 | 3.7 |

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.

REFERENCES

AOAC (1995). Method of Analysis Association of Official Agriculture Chemists. 16th Ed. Washington, D. C, USA.

Chang, R.Z., Y.W. Chen, G.H. Shao and C.W. Wan (1994). Effect of salt stress on agronomic characters and chemical quality of seeds in soybean. Soybean Scince, 13:101-105.

Chen, Y., P. Chen and B.G. Reyes (2006). Differential responses of the cultivated and wild species of soybean to dehydration stress. Crop science, 46(5):2041-2046.

CoStat-Cohort Software (2005). CoStat User Manual, version 3 Cohort Tucson, Arizona, USA.

Delgado, M.J., F. Ligero and C. Liuch (1994). Effects of salt stress on growth and nitrogen fixation by pea, faba-bean, common bean, and soybean plant. Soil Biological and Biochemistry, 26:371-376.

FAO (2018). Soybean, cultivated area and production. Food and Agriculture Organization of the United Nation, 2018.

Gomez, K.A and A.A. Gomez (1984). Statistical procedures in agricultural research. 2nd edition. Wiley, NewYork.

Gutierrez-Coronado, M.A., C. Trejo-Lopez and A. Larque-Saavedra (1998). Effects of salicylic acid on growth of roots and shoots in soybean. Plant Physiology Biochemistry, 36:653-665.

Hasanah, Y. and M. Sembiring (2018). Effect of foliar application of chitosan and salicylic acid on the growth of soybean (Glycine max L.) Merr.) varieties. In IOP Conference Series: Earth and Environmental Scince, 122 (1):12-27.

Khodary, S.E.A. (2004). Effect of salicylic acid on the growth, photosynthesis and carbohydrate metabolism in salt-stressed maize plants. International Journal of Agriculture Biological, 6:5-8

Livestock's long shadow (2016).Environmental issues and options. www.fao.org. Retrieved 2016-01-15.

Naoki, M. K. Fukami and S. Tsuchiya (2016). Effects of early planting and cultivars on the yield and agronomic traits of soybean grown in southwestern Japan. Plant Production Scince, 19 (3): 370–380.

Noreen, S., Ashraf, M., and N.A. Akram (2012). Does exogenous application of salicylic acid improve growth and some key physiological attributes in sunflower plants subjected to salt stress?. Journal of Applied Botany and Food Quality, 84:169-177.

Page, A.L., R.H. Miller and D.R. Keeney (1982). Methods of Chemical Analysis. Part 2: Chemical and Microbiological Properties (2nd Ed.). American Society of Agronomy, Inc. and Sci. Soc. of America, Inc. Publi., Madison, Wisconsin, U.S.A.

Parvaiz, A., and S. Satyawati (2008).Salt stress and phytobiochemical responses of plants – a review. Plant Soil Environment, 54: 89–99.

Pasala, R.K., M.I.R. Khan, P.S. Minhas, M.A. Farooq, R. Sultana, T.S.Per, , P.P. Deokate, N.A. Khan and J. Rane (2016). Can plant bioregulators minimize crop productivity losses caused by drought, heat and salinity stress? An integrated review. Journal of Applied Botany and Food Quality, 89, 113-125.

Raskin, I. (1992). Role of salicylic acid in plants. Annual Review of Plant Biology, 43: 439-463.
Sadeghi, S.M. and S.N. Niyaki (2013). Effects of Planting date and cultivar on the yield and yield components of soybean in north of Iran. *Journal of Agriculture and Biological Science*, 8(1): 81-85.

Singleton, P.W. and B.B. Bohlool (1984). Effect of salinity on nodule formation by soybean. *Plant Physiology*, 74:72-76.

Soares, T.C.B., P.I.V. Good-God, F. D. Miranda, Y.J.B. Soares, I. Schuster., N.D. Piovesan, E.G. Barros and M.A. Moreira (2008). QTL mapping for oil content in soybean cultivated in two tropical environments. *Pesquisa Agropecuária Brasileira*, 43(11): 1533- 1541.

Stevens, J., T. Senaratna and K. Sivasithamparam (2006). Salicylic acid induces salinity tolerance in tomato (*Lycopersicon esculentum* cv. Roma): associated changes in gas exchange, water relations and membrane stabilization. *Plant Growth Regulation*, 49: 77-83.
تستجابة بعض أصناف فول الصويا المصرية والعراقية لحامض السالسيك تحت ظروف الملوحة
محمود عبد العزيز جمعة، عصام إسماعيل إسماعيل قنديل، جوهرة عبد السلام الصردي
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قسم الأنتاج النباتي – كلية الزراعة – سابا باشا – جامعة الأسكندرية

فول الصويا ينتمي إلى العائلة البقولية وهو من المحاصيل الغذائية والصناعية الهامة على المستوى المحلي والعالمي. يزرع لغرض استخراج الزيت الذي ينمو في الطعام كما أنه يدخل في مجموعة من الأغذية والأدوية. وتتميز فوائد فول الصويا في المحاصيل الزراعية ودوره الدلتا في تقليل هذه المخاطر والتوسع في هذه المحاصيل، والذي يبرأته في الأراضي الجذابة والعمل على زيادة الإنتاجية بسبب الري أنجبت هذه الدراسة في مزرعة منطقة البحيرة – محافظة البحيرة خلال الموسم الصيفي لعامي 2019 و 2020. وتلك الدراسة تأثر عدد مرات الرش من حامض السالسيك على بعض أصناف فول الصويا المصرية العراقية تحت ظروف ملوحة مياه الري تحت نظام الري بالتنقيط.

ووزعت المعاملات عشوائياً تصميم تجريبى هو القطع المنشقة متعددة، حيث:

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

ب- القطع تحت الرئيسية: مرات الرش بحمض السالسيك:
1- الرش بالماء (المعاملة المقارنة).
2- الرش مرة واحدة (بعد 30 يوم من الزراعة).
3- الرش مرتين (بعد 30 و 50 يوم من الزراعة).
4- الرش الورقي مرتين (بعد 30 و 50 و 70 يوم من الزراعة).

المعاليم الزراعية الأخرى أجريت كنصائح تنمية الزراعة باستخدام نظام الري بالتنقيط خلال موسمي الزراعة.

وبينت النتائج أن:
- يوجد اختلاف بين أصناف فول الصويا العراقية فيما يتعلق بجميع الصفات المدروسة مثل ارتفاع النبات (سم) وعدد الأفرع للنبات، وعدد الفروع ووزن 100 بذرة (جم) ومحصول البذور (كم/طن) ومحتوى النبات من الزيت (كجم/مليون) ونسبة الزيت في الزيت (%) تحت ظروف مياه الري الملحية باستخدام نظام الري بالتنقيط خلال موسمي الزراعة.
- زيادة عدد مرات الرش الورقي لمحاصيل السالسيك حققت زيادة معنوية في معظم الصفات المدروسة تحت ظروف التجربة، وسجل الرش مرتين عند 30 يوم من الزراعة أعلى متوسط قيم للصفات تحت الدراسة وبعدها بittings، ومعاملة الري الماء أعلى القيم للصفات المدروسة خلال موسمي الدراسة.
- التداخل بين عاملي الدراسة كان له تأثير معنوي حيث وجد أن الري الورقي لمحاصيل السالسيك مرتين أو ثلاثة مرات ومعنوي 1000 يوم في المليون أعطيت هذه الدراسة أعطى أقصى قيمة لمعدل معيشة الري والتنقيط في اليوم تحت ظروف مياه الري الملحية خلال موسمي الدراسة.

التوصية:
- من النتائج السابقة يوصى البحث بزراعة صنف فول الصويا المصري (جيزة 111) مع الرش الورقي مرتين أو ثلاثة مرات ومعنوي 1000 يوم في المليون. عن هذه النتائج، فإن نتائج الري الورقي من محاصيل السالسيك يعتبر أفضل ما يتم استخدامه في الري الملحية وعند نظام الري بالتنقيط وخلال موسمي الدراسة وتحت ظروف منطقة النوبارية.