Effect of Soaking with in Acid Solution on Sunflower Helianthus anuus L. Germination and Field Emergence.

M. A. Sfaean¹ and M. H. I. Alani²*

¹College of Education for Pure Sciences – University Of Anbar, Iraq.
²College of Agriculture - University Of Anbar, Iraq.

Abstract. A field experiment was conducted in a private field in Anbar Governorate, adjacent to the Euphrates River, for the growing season 2020/2021. In order to study the effect of soaking the seeds of sunflower varieties (Hysun), (Lulio), (Ishaqi 1) and (Sakha), with a solution of ascorbic acid (0, 50, 100 and 150 mg.L⁻¹), on germination some qualities of field emergence. The results showed the significant superiority of soaking in all the studied traits, Where the concentration (150 mg. L⁻¹) achieved the best results in the rates of the studied traits, 79.25% emergence percentage, 72.78% germination energy, 4.75 days to germination, 16.33 cm shoot and 9.35 cm root length. The results also showed the superiority of the (Hysun) cultivar in the characteristic of the final emergence percentage, (90.3%), while the cultivar Ishaqi 1 scored the lowest average for the trait, 43.1%, and the variety Sakha gave the highest rate of germination capacity (66.7%), while the variety gave Lulio recorded the lowest rate (36.7%), The cultivar Lulio gave the lowest average germination time, reached 4 days, while the Lulio cultivar gave the longest average (9 days). In terms of shoot length, the Hysun variety recorded the highest rate of 16.55 cm, While the Ishqi cultivar recorded the lowest, shoot length (8.93 cm), The variety (Sakha 1) recorded the highest average for the length of the rootstock which was 16.33 cm, while the (Lulio) variety recorded the lowest rates (10.64 cm).

1. Introduction

The sunflower crop Helianthus anuus L. is the second most important crop in the world after soybeans, because its seeds contain a high percentage of oil, reaching more than 50% depending on the cultivar cultivated, [1, 2]. These oils are important as food for humans because they contain omega-3 that have no side effects on human health, and they also contain unsaturated fatty acids such as (Oleic acid and Linoleic acid), and they also contain vitamins such as vitamins A, D and E, [3]. The sunflower plant is a good fodder for farm animals as well as poultry due to its high protein content of 36% and carbohydrates 21%, and it is also used to feed bees [4]. The seeds used to grow the crop were mostly imported varieties or internal strains, however, during the past decades, attempts have been made in many Iraqi scientific research institutions to produce genotypes of sunflower that are adapted to the climate and soil type in different regions of Iraq, [5].

In a study by Buettner & Schafer [6] to study the effect of stimulating sunflower seed treatment with citric acid and ascorbic acid, at concentrations (0, 40, 80, 120 mg / L⁻¹), significant difference were recorded for the fresh weight and dry weight of the seedlings in the seeds. The infusion compared to the comparison treatment, especially when activated with ascorbic acid at a concentration of (120 mg / L⁻¹). In a field study by [7] to study the effect of ascorbic acid in concentrations (0, 100, 200 and 300 mg. L⁻¹) on sunflower seeds, growth characteristics, seedling height and dry weight of the seedling, the results in most cases showed that all parameters were significantly increased using ascorbic acid concentration (100 mg. L⁻¹).

The performance of the seeds of varieties varies in the laboratory due to genetic or environmental factors, and the effect of this difference can be observed in their response to the study factors. Varieties differ in seedling growth rates in addition to the difference of one variety from year to year due to the genetic or environmental influence or the overlap between them Genetic control, this variation mostly depends on the rates of metabolic compounds and other raw materials coming from the mother plant to the seed, which control this genetic trait, as well as the possibility of genetic control within the seed itself [8].
Seed preparation is a useful technique control procedure followed by re-drying that will allow the seeds to drink water to stimulate the internal biological process necessary for germination but this process will not allow the seeds to truly germinate. At present, many methods of seed preparation have been used such as hydrophilic preparation, thermal priming, bio-priming; many studies have confirmed that seed preparation has many advantages, including early emergence with high efficiency, germination of taller roots over a wide range of temperatures, resistance to disease and environmental stresses [9].

Among the most important stimulants of seeds is ascorbic acid, as it acts as an antioxidant and an enzyme factor as a growth regulator and plays an important role in various processes, including photosynthesis, protection from light, cell wall growth and resistance to cell expansion to the environment [10, 11] explain the effect of stimulating sunflower seeds on field emergence, early growth and some physiological processes when soaking in water and solutions of ascorbic acid (200 mg / L\(^{-1}\)) and succinic acid (50 mg / L\(^{-1}\)) Also.

[12] explained the effectiveness and the important role of ascorbic acid in increasing plant growth rates by stimulating cell division, doubling, elongation and extending the size of plant parts such as roots, leaves and stems. Ascorbic plays multiple roles in plant growth, such as cell division, cell wall expansion, and other developmental processes. Therefore, our study aims to demonstrate the germination performance of seeds of sunflower varieties soaked with ascorbic acid under field circumstance.

2. Materials and Methods

A field experiment was conducted in a private field in Anbar Governorate, adjacent to the Euphrates River, for the growing season 2020 / 2021. To study the effect of seeds soaking of four varieties of sunflower seeds (Helianthus annuus L.) Hysun (Sudanese), Lulio (French), Ishaqi 1 (Iraqi) and Sakha (Egyptian) with four concentrations of ascorbic acid (0, 50, 100, 150 mg / L\(^{-1}\)) For the purpose of studying improving the characteristics of field emergence.

The experiment was applied with a Randomized Complete Block Design (RCBD) with three replications for each treatment (Global experiences). The seeds were blended for the purpose of mixing and to complete the homogenization process appropriately and divided [13]. To ensure the cleanliness of the seeds, they sterilized with sodium hypochlorite at a concentration of 8% for 10 minutes [14]. Then the seeds were rinsed well with water several times to get rid of the sterile effect, then the seeds were dried by placing them between two blotting papers. The seeds were sterilized with a sodium hypochlorite solution at a concentration of 8% for 15 minutes to ensure the addition of the seeds [15]. Then the seeds were washed from the polluted material with distilled water for several times to ensure that all traces of the polluted material were eliminated in order not to affect the viability of the seeds [16] and the seeds were re-dried from distilled water by placing them on blotting paper and below room temperature.

The process of soaking in ascorbic acid in sealed plastic cans was made and the soaking solution was prepared from dissolving vitamin C in distilled water, and 75 seeds per treatment of concentrations were soaked in the acid for 6 hours for each concentration except for the comparison treatment (control). After completing the soaking process, the seeds were washed well with distilled water and several times also to get rid of the traces of the soaking substance. Seeds are dried at room temperature to a normal moisture level before planting. With medical alcohol at a concentration of 97%, all materials used in the processes of soaking, washing, drying and workplaces have been completely sterilized.

The study included the experience of sunflower seeds soak in ascorbic acid, where the seed was planted by 25 per treatment and the total concentration of 75 per seed repeaters, according to the recommendations of [17], and in the breeding and plastic fusion Snadin sterile capacity of 10 kg were planted seeds.

2.1. Studied field qualities

1- The percentage of emergence: - It was done according to the following equation:
   \[
   \text{Emergence} \% = \frac{\text{number of seedlings}}{\text{number of seeds planted}} \times 100
   \]

2- Energy Germination (%): - The use of the following equation percentage of energy germination =
   \[
   \text{Energy Germination} \% = \frac{\text{number of seedlings in the fourth day}}{\text{number of seeds}} \times 100
   \]

3- The time required for emergence (day): It is the time between the first and the last state of emergence or germination of the quantity of seeds, and the largest values indicate the highest difference in the speed of emergence or germination between the slow and rapid emergence of the quantity of seeds.
4- Shoot length (cm): - The length of 5 seedlings was measured randomly after 15 days of seeding. A tape measure inserted with a cm unit was measured from the level of the soil surface to the top of the precursor and the averages of these readings were taken to calculate the rate of height of the seedling.

5- The length of the root (cm): - 5 plants were pulled from the soil for all the parameters and the length of the roots was measured by a measuring ruler listed in (cm) and divided by 5 to take the mean.

3. Results and discussion

3.1. The ratio of the final emergence (%)

It is noticed from Table (1) that there are significant differences in the percentage of final emergence affected by the varieties, as the Hysun variety gave the highest percentage of 74.33%. Whereas, the Ishaqi variety 1 gave the lowest percentage of the studied trait, which was 52.33%, while the Lulio variety recorded an average of 61.25%, and the variety Sahakha recorded an average of 71.3%. The reason for this is due to the difference between the varieties in their genetic variation and seed vigor, which leads to a variation in the variety's response to the stimulant that is also different. [18].

Table (1) also shows that the concentration (150 mg / liter -1) gave the highest germination rate, which reached 79.25%, while the comparison treatment recorded the lowest percentage of the studied trait, which reached 48.074%, The rest of the soaking concentrations recorded the values of 62.51% and 69.88%, and for this reason may be due to the ability of ascorbic acid to increase cell activity, And increasing the percentage of oxygen uptake, which leads to an increase in the level of metabolism within the cells, in addition to improving and increasing the RNA and DNA present in the seed [19].

As for the overlap of traits in Table (2), which was significant among the study factors, as the Hysun variety soaked at a concentration of (150 mg / liter-1) gave the highest germination rate of 90.5%, while the cultivar Ishaqi 1 in the concentration of the comparison treatment scored the lowest, reaching 43.0%.

Table 1: Effect of soaking four varieties of sunflower seeds in concentrations of ascorbic acid on the percentage of final emergence (%).

| Ascorbic acid modifier | Varieties | concentrations mg.L-1 |
|------------------------|-----------|----------------------|
|                        | Sakha     | Ishaqi 1 | Lulio | Hysun |
| 48.075                 | 50.3      | 43.0     | 46.0  | 53.0  |
| 62.51                  | 68.3      | 51.0     | 59.0  | 69.7  |
| 69.88                  | 77.3      | 50.6     | 67.3  | 84.3  |
| 79.25                  | 89.3      | 64.7     | 72.7  | 90.3  |
| 71.3                   | 52.33     | 61.25    | 74.33 |       |

l.s.d Soaking concentrations 11.22 Varieties 11.22 interaction 22.44

3.2. Germination energy (%)

Table (2) shows that there is a significant difference in the germination capacity affected by the cultivars, as the Sakha variety gave the highest average germination capacity (60.65%) ; the variety Ishaqi 1 gave the lowest average rate for the studied trait of 50.43%, and the reason for this is that the variation in germination energy mostly depends on the rates of metabolites and other raw materials , Coming from the parent plant to the seed, which is controlled by the genetic content of the seeds of the variety, [20].

Table (2) shows that the concentration (150 mg. L-1) gave the highest value for the studied trait, which reached 72.78%, registering a significant difference from the remaining concentrations (0, 50, 100 mg. L-1), which recorded 48.93, 56.17 and 70.18%, respectively. The reason for this is because ascorbic acid, its role lies in the fact that it is a cofactor in the phosphorylation processes in the process of photosynthesis, and an important regulator of the redox states of the protoplasm , And as an influencer in the case of oxidation and activity of some important enzymes inside the plant, [21]. Also, the superiority of the activation treatment in the percentage of final eruption causes the superiority of germination energy.
Table (2) also indicated that there was significant overlap between the study workers, as the cultivar Sakha gave the highest germination capacity that reached 79.8% and soaked at a concentration of (150 mg. Lit. -1), while the cultivar Lulio recorded the lowest values of the studied trait reached 42.7% at a concentration of 0 mg -1.

Table 2. Effect of soaking four varieties of sunflower seeds in concentrations of ascorbic acid on germination energy (%)

| Ascorbic acid modifier | Varieties | Concentrations Mg. L -1 |
|------------------------|-----------|------------------------|
|                        | Sakha     | Lulio                  | Hysun      |
| 38.9                   | 36.4      | 39.3                   | 36.7       | 38.3       | 0          |
| 48.88                  | 54.7      | 45.3                   | 46.8       | 48.7       | 50         |
| 62.05                  | 71.7      | 52.4                   | 55.7       | 68.4       | 100        |
| 72.78                  | 79.8      | 66.7                   | 69.3       | 73.3       | 150        |
| 60.65                  | 50.43     | 52.12                  | 57.17      |            |            |

The average of the trades
0.83. 8 0.53. 5 0.53. 5 0.53. 5

L.s.d Soaking concentrations 8.87 Varieties 8.87 interaction 19.73

3.3. Time taken for field emergence (day)

Table (3) indicates that there is a significant difference in the time taken for germination affected by the varieties, as the variety Sakha gave a lower bloom and an average germination time of 5.50 days. While the Lulio variety recorded the highest average for the trait, reaching 7.78 days, and the rest of the varieties recorded an average period of 6.58 days for Hysun and 6.66 days for Ishaqi 1. The reason for this is due to the different genetic content of the varieties and environmental overlap [22].

Table (3) also showed that there was a significant difference in the effect of the concentrations on the average of the studied trait, where the concentration (150 mg. Lit. -1) gave the lowest average for the number of days, reaching 4.75 days. While the concentration of the comparison treatment gave the highest average for the studied characteristic, which was 8.58 days, and the remaining concentrations were recorded at 7.64 and 4.75 days, respectively. This is due to the effectiveness and the important role of ascorbic acid in increasing plant growth rates by stimulating cell division and multiplication. Ascorbic acid has the ability to accelerate cell division, thus reducing the time taken for germination, and activating the effectiveness of many important enzymes in regulating growth processes, [23]. Also, table (3) shows that the interaction between the two study workers has a significant difference, as the variety gave Sakha soaked in a concentration of (150 mg . L -1) the lowest average duration of interaction amounted to 3.07 days. While the Lulio cultivar recorded the highest average time overlap of 9.00 days in the comparison treatment.

Table 3. Effect of soaking four varieties of sunflower seeds in concentrations of ascorbic acid, time taken for emergence (day)

| Ascorbic acid modifier | Varieties | Concentrations Mg.L -1 |
|------------------------|-----------|------------------------|
|                        | Sakha     | Lulio                  | Hysun      |
| 8.58                   | 8.33      | 8.33                   | 9.00       | 8.67       | 0          |
| 7.61                   | 6.06      | 7.23                   | 8.78       | 7.33       | 50         |
| 6.37                   | 5.33      | 6.67                   | 7.33       | 5.67       | 100        |

4
The average of the trades

3.4. Shoot length (cm)

Table No. (4) shows that there is a significant difference in the length of the feather affected by the varieties, as the Hysun variety gave the highest average feather length of 13.17 cm. While the cultivar Lulio scored the lowest average for the trait at 10.58 cm, while the variety Sakha scored a rate of 12.85 cm, and the variety Ishaqi 1 recorded 10.65 cm. The reason for the difference in the varieties in the length of the feather is due to the difference in its genotype controlling the elongation of cells and the length of the feathery [24], and the speed of field emergence of the varieties may be the reason for the increase in the feather length.

Table No. (4) shows that there was a significant difference in the effect of the concentrations, the concentration (150 mg. Liter -1) gave the highest average for the studied trait, which reached 14.47 cm, while the rest of the concentrations gave lower values of 12.96, 10.48 and 9.34 cm. According to the sequence, and the reason for the high average concentrations is due to the effectiveness and the important role of ascorbic acid in increasing the rates of plant growth by stimulating cell division, doubling, elongation and expanding the size of plant parts [25].

Table No. (4) indicates that there are significant differences between the two study workers, as the Hysun variety at a concentration of (150 mg. Liter -1) gave the highest average values for the studied trait of 16.55 cm, whereas, the Lulio cultivar, at the comparison treatment concentration, scored the lowest, reaching 10.65 cm.

Table 4. Effect of soaking four varieties of sunflower seeds in concentrations of ascorbic acid in the feather length (cm).

| Concentrations Mg.L-1 | Varieties      | Ascorbic acid modifier |
|-----------------------|----------------|------------------------|
|                       | Hysun | Lulio | Ishaqi | Sakha |
| 0                     | 9.87  | 8.99  | 9.56   | 9.34  |
| 50                    | 11.81 | 9.62  | 11.73  | 10.48 |
| 100                   | 14.46 | 11.45 | 12.77  | 12.96 |
| 150                   | 16.55 | 12.24 | 13.77  | 14.47 |
| 200                   | 18.33 | 13.58 | 15.28  | 15.07 |

l.s.d  Soaking concentrations 1.245  Varieties 1.245  interaction 2.490

3.5. Root length (cm)

The results of Table No. (5) show that there is a significant difference between the varieties affected by soaking, as the variety Sakha gave the highest average value of the studied trait, which reached 8.61 cm. Whereas, the cultivar Lulio gave the lowest mean of the trait of 5.87 cm, and the variety was Isaac 1 6.01 cm. The, which leads to a difference in the expression of the genetic material in each variety affected by the environment. Genetic characteristics also control the amount of food material transferred to different plant tissues [26].

Also, the significant effect of the concentrations of ascorbic acid on the average characteristic was recorded, where the concentration (150 mg. Liter-1) gave the highest average concentrations of 9.35 cm, while the rest of the concentrations recorded the rates of 5.04, 6.29 and 8.39 cm, respectively. The reason is that ascorbic acid plays multiple roles in plant growth, such as cell division, cell wall expansion,
increase in the number of cells and elongation within plant tissues, and the important role of ascorbic acid in increasing plant growth rates by stimulating cell division, doubling, elongation and expanding the size of plant parts.[27].

Table (5) indicates that there was a significant difference in the interaction between the two study workers, as the Hysun variety recorded the highest rate of the studied trait at 11.97 cm and in the soaking concentration (150 mg. Liter-1), while the Lulio cultivar recorded the lowest average of the root length of 5.87 cm. In a comparison transaction.

**Table 5.** Effect of soaking four varieties of sunflower seeds in concentrations of ascorbic acid in the length of the rootstock

| Ascorbic acid modifier | Varieties | Concentrations Mg.L-1 |
|-----------------------|-----------|----------------------|
|                        | Sakha     | Ishaqi l | Lulio | Hysun |          |
| 5.04                  | 5.06      | 4.84     | 4.80  | 5.47  | 0        |
| 6.29                  | 7.09      | 5.64     | 5.37  | 7.05  | 50       |
| 8.37                  | 10.88     | 6.40     | 6.43  | 9.78  | 100      |
| 9.35                  | 11.41     | 7.16     | 6.87  | 11.97 | 150      |
| 8.61                  | 6.01      | 5.87     | 8.57  |       |          |

l.s.d Soaking concentrations 1.190 Varieties 1.190 interaction 2.379

4. Conclusion

According to the results of the study, it became clear that the cultivars Hysun and Sakha were more distinguished among the rest of the varieties at a concentration of 150 mg L⁻¹ of ascorbic acid under field conditions.

References

[1] Kathiresan, K., Kalyani, V., & Gnanarethinam, J. L. 1984. Effect of seed treatments on field emergence, early growth and some physiological processes of sunflower (Helianthus annuus L.). *Field Crops Research*, 9, 215–217.

[2] Attia, Hatem Jabbar and Khudair Abbas Jadou’. 1999. Plant growth regulators theory and practice. Ministry of Higher Education and Scientific Research. P. P.: 327.

[3] Razaji, A., Farzanian, M., & Sayfzadeh, S. 2014. The effects of seed priming by ascorbic acid on some morphological and biochemical aspects of rapeseed (Brassica napus L.) under drought stress condition. *Int. J. Biosci.*, 4(1), 432–442.

[4] Mohamed, A. B., El-Banna, M. F., Farouk, S., & Khafagy, M. A. 2019. The role of grain priming and its duration on wheat germination and seedling growth. *Journal of Plant Production*, 10(4), 343–349.

[5] Abdullah, S. K., & Al-Mosawi, K. A. 2010. Fungi associated with seeds of sunflower (Helianthus annuus) cultivars grown in Iraq. *Phytopathologia*, 57, 11-20.

[6] Buettner, G. R., & Schafer, F. Q. 2001. Ascorbate (Vitamin C), its antioxidant chemistry. *Society For Free Radical Biology and Medicine*, 20.

[7] Abdel-Hafeez, A. A., Abd El-Mageed, T. A., & Rady, M. M. 2019. Impact of ascorbic acid foliar spray and seed treatment with cyanobacteria on growth and yield component of sunflower plants under saline soil conditions. *International Letters of Natural Sciences*, 76, 136-146.
[8] A. L - Sahuki, Medhat Majeed. 2009. Seed growth relationship. College of Agriculture - University of Baghdad. Ministry of Higher Education and Scientific Research. P. P.: 150

[9] Nasrallah, Adel Youssef and Intisar Hadi Al-Halfi, Hadi Muhammad Al-Aboudi, Aws Ali Muhammad and Ahmed Mahdi Mahmoud 2014. The effect of spraying some plant extracts and antioxidants on the growth and yield of sunflower. *Iraqi Journal of Agricultural Science*. 45 (7), 651-659.

[10] Shaari, K., Khoo, K. C., & Ali, A. R. M. (1991). Oil palm stem utilisation, review of research.

[11] Kader, M. A. (2005). A comparison of seed germination calculation formulae and the associated interpretation of resulting data. *Journal and Proceeding of the Royal Society of New South Wales*, 138, 65–75.

[12] Bekele Benjawu, t. 2019. effect of gypsum and farmyard manure on selected physicochemical properties of saline sodic soil, yield and nitrogen use efficiency of rice (oryza sativa l.) at amibara, ethiopia. haramaya university.

[14] Ashraf, M., & Tufail, M. (1995). Variation in salinity tolerance in sunflower (Helianthus annum L.). *Journal of Agronomy and Crop Science*, 174(5), 351–362.

[15] Dolatabadian, A., Sanavy, S. A. M. M., & Chashmi, N. A. 2008. The effects of foliar application of ascorbic acid (vitamin C) on antioxidant enzymes activities, lipid peroxidation and proline accumulation of canola (Brassica napus L.) under conditions of salt stress. *Journal of Agronomy and Crop Science*, 194(3), 206–213

[17] Habib, Marwa Ismail. 2018. Improving the performance of degraded sunflower seeds using an activation treatment. *Master Thesis* - College of Agriculture - Anbar University

[18] Al-Hawari, Muhammad Ibrahim Ibrahim. 2010. Principles and applications of seed science and technology. National Genome Bank - Agricultural Research Center, Al-Tobgy Press, Egypt. P. P. 169

[19] Al - Silawi, Razak Laftah. 2011. Growth and yield response of some rice varieties for seed activation. *PhD thesis* - Department of Field Crops - University of Baghdad. P. s . 106

[20] Moghanibashi, M., Karimmojeni, H., Nikneshan, P., & Behrozi, D. (2012). Effect of hydropriming on seed germination indices of sunflower (Helianthus annuus L.) under salt and drought conditions. *Plant Knowledge Journal*, 1(1), 10–63

[21] Al-Hajri, Ruwaida Abdulaziz, 2017. The role of salicylic acid and ascorbic acid in increasing carrot plant resistance to drought stress. *Master Thesis*. College of Science - Taibab University - Kingdom of Saudi Arabia

[22] Mahmood, T., Iqbal, N., Raza, H., Qasmi, M., & Ashraf, M. Y. 2010. Growth modulation and ion partitioning in salt stressed sorghum (Sorghum bicolor L.) by exogenous supply of salicylic acid. *Pak. J. Bot.*, 42(5), 3047–3054.

[23] Ozturk, L., Yazici, M. A., Yusuf, C., Torun, A., Cekic, C., Bagci, A., Ozkan, H., Braun, H., Sayers, Z., & Cakmak, I. (2006). Concentration and localization of zinc during seed development and germination in wheat. *Physiologia Plantarum*, 128(1), 144–152.

[24] Farooq, M., Basra, S. M. A., Ahmad, N., & Hafeez, K. (2005). Thermal hardening: a new seed vigor enhancement tool in rice. *Journal of Integrative Plant Biology*, 47(2), 187–193.

[25] Al-Fakhry, Abdullah Qasim and Ahmed Saleh Khalaf. 1983. Crop seed production and quality. Ministry of Higher Education and Scientific Research. University of Al Mosul . P. P. 609.

[26] Ista, E., van Dijk, M., Tibboel, D., & de Hoog, M. (2005). Assessment of sedation levels in pediatric intensive care patients can be improved by using the COMFORT “behavior” scale. *Pediatric Critical Care Medicine*, 6(1), 58–63.
[27] Al-Rubaie, Abdullah Hammoud Abdullah. 1984. The effect of storage conditions on germination, seedling growth, and chemical composition of seeds for some important crops. Master Thesis, Faculty of Agriculture and Forestry - University of Mosul