Evaluation of the response of five varieties of potato plant (Solanum tuberosum L.) For saline stress under the conditions of Basra

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A field experiment was conducted at al-Faris agricultural testing station during the autumn season of 2019-2020, which is located in Zubair district, which is located approximately 25 km southwest of Basra governorate in sandy loam soil, with the aim of assessing the response of five varieties of potato plant (V1, V2, V3, V4, V5) for different levels of saline stress (S1= 1.5, S2= 3.5, S3= 5.5, S4= 7.5) \( \text{d S/m} \). The study was done as a factorial experiment based on randomized complete block design with three replicates (R.C.B.D), 60 experimental units resulting from (five varieties and four saline levels) \( \times 3 \) repeaters. It was noted from the results that V1 \( \times S1 \) is significant effect in most of the qualities studied if it gives the highest rates for each of the following qualities, weight of tuber g. plant\(^{-1} \), Number of tubers/plants, the yield of one plant g and the total yield of a ton. donem\(^{-1} \) and its rates were as follows (85.92 g. plant\(^{-1} \), 6.35 tubers. Plant\(^{-1} \), 546.10 g, 5.34 tons. donem\(^{-1} \)). (V3, V4) \( \times S4 \) gave the lowest rates for most trained qualities, and the plants of the V1, V2 gave the high rate of the percentage of dry matter in tubers and the percentage of starch \%.

1. Introduction

The potato (Solanum tuberosum L.) One of the most important tuber plants used in human food as it is a cheap and useful food source because of its important nutrients such as carbohydrates and amino acids (9), that the production of potato plant is influenced by many factors including variety and environmental conditions planted in the plant in addition to the processes of service soil and plant and methods and type of water used in irrigation, many studies have been carried out in many countries of the world to determine the response of varieties to the environmental conditions cultivated in them, because the varieties are one of the most important factors that determine productivity as a result of the interaction between genetic factors and environmental conditions, genetic factors determine the degree of growth and development of the organism so they greatly affect the quantity and quality of the crop as well as the environmental conditions prevailing during the period of growth(12), (4) in Saudi Arabia when studying seven varieties of potatoes grown under the conditions of the glass house, indicated the significant effect between these varieties, safrane cultivar gave the high rate of components of the product, including the weight of tuber , In a study of five varieties of potatoes Volare, Arizona, Riviera and Arnova, Volare also found a moral superiority if given (7.18 g.n. plant) as a single plant, marketing and total yield , which amounted to (209.96 )tons.ha\(^{-1} \) and (341.97 )tons.ha.1- Arizona gave the best quality qualities to the product percentage of dry matter, percentage of growth in tubers, specific density of tubers and percentage of protein (6), (8) found when studying three varieties of potatoes, Ajiba surpassed the rest of the varieties in the qualities of tuber weight, tubers, and the total tubers (13) noted when studying three varieties of potatoes, luzita , buren and orla , burin it have significant effect in the total and marketing characteristics ton / ha.

Salinity is one of the stresses to which the plant is exposed and which directly and indirectly affects many vital events within the plant, which in turn affect saline and salinity reduce the readiness of water available to the plant (11), Potato is classified in terms of salinity tolerance to medium-tolerance plants, the stress leads to a clear decrease in potato growth indicators (the product and its component). (18) indicated that there was a clear decrease in the incidence and ingredients of potato plants (number of tubers.plant\(^{-1} \), weight of tuber g., plant-plant, percentage of dry and growing matter) by increasing salt levels in irrigation water, (2) noted when using three levels of irrigation water salinity (6.1, 2.3 and 3.4) \( \text{ds/m} \) that increased salinity levels led to a marked decrease in the total and marketable yield.

The increased of salinity problem in Basra governorate has need to grow some verities that are tolerant of salinity, the aim of this study which included planting five varieties of potato and studying their tolerance to different levels of irrigation water salinity, and choosing the best and most tolerant.
2. Materials and Method

A field experiment was carried out in the autumn season for the agricultural season 2019-2020, at al-Faris agricultural test station located in Zubair district, which is about 25 km southwest of Basra governorate in mixed sand soil. Soil samples were taken at a depth of 0-30 cm for the purpose of conducting some chemical and physical analyses, as an analysis of the water of the well-used by agriculture was carried out in the laboratories of the Center for Marine Sciences / University of Basra (Table 1). The study was done as a factorial experiment based on randomized complete block design with three replicates, where the experiment was applied a factor Two factors represented the first factor items and included five varieties (V1 = BUREN, V2 = RIVERA, V3 = FANDANGO, V4 = VOUGE, V5 = ARIZONA) obtained from The Day Orad Potato and Agricultural Supplies Company. And four levels of salinity (S1 = 1.5, S2 = 3.5, S3 = 5.5, S4 = 7.5) d S/m. The irrigation was carried out using four water tanks with a capacity of 1000 liters like each tank level of irrigation water and this was done by dilute the salinity water of the well according to the concentrations used in the experiment. The number of experimental units involved in the experiment was 60 experimental units resulting from the cultivation of five varieties in four salinity levels and three replication, the averages of the results were analyzed statistically using the statistical program Genstat 2013 and used the test of the lowest significant difference rate (L.S.D.) its an indicator to the difference between mean of treatment, at the probability level of 0.05 (Al-rawe and Khalafallah, 1980).

The land was prepared for agriculture by tilled twice perpendicularly and added to it the decaying animal manure (cow residues) at a rate of 8 tons/don. Tubers were cultivated in the distance between furrows and the last 75 cm and between plants 25 cm and left a distance of 1 meter between transactions, the length of the furrows was 30 meters included each furrows on (120) plants used the drip irrigation system under the french-made T-Tape type, which contained points for irrigation plants. All soil and crop service operations were carried out as follows in the production of potato, and the process of incubation (incubated) of plants was conducted about a month after the germination process (Matlob and others, 1989), planted tubers on 1/10/2019 at a depth of 10 cm (Abbas, 2015).

The studied traits included the following:

1- weight of the tuber (g. plant⁻¹): according to the rate by dividing the yield of one plant by the number of tubers. Plant⁻¹ in each experimental unit
2- average number of tubers (tubers/ plants) : the average number of total tubers per plant by taking the total tubers of the plants specified in the experimental unit and dividing them by their number.
3- The product of one plant (g/plant): by dividing the product of the plants that were taken for measurement by their number
4- Total yield (ton/don): The yield of one plant per experimental unit was calculated and then converted to the don. according to the following equation: Total yield = single plant yield * Number of plants / don.
5- 4- Marketing yield (ton/don.): The total yield was calculated after the exclusion of small tubers and then the weight of the remaining and around the don.
6- Dry matter percentage in tuber ( % ) : Dry weight of tubers / wet weight for tubers) * 100
7- Percentage of starch %: The following equation was used to estimate the percentage of starch in tubers as stated in A.O.A.C. (1975):

\[
\text{Percentage starch} = 17.550 + 0.891 \times (\%\text{dry matter for tubers} - 24.180).
\]

Table (1) Some physical and chemical properties of the soil and water of the experiment field (2019-2020)

| Valuable field soil               | Value       |
|-----------------------------------|-------------|
| Sand %                            | 80.54%      |
| Loam %                            | 11.67%      |
| Clay %                            | 7.14%       |
| Soil texture                      | Sandy loam  |
| E-level of electrical conduction of soil solution (E.C) | 6.86 d S.m⁻¹ |
| Soil pH                           | 7.19        |
| Total nitrogen (mg.kg⁻¹)          | 0.025       |
| Phosphorus (mg.kg⁻¹)              | 0.21        |
| Ready potassium (mg.kg⁻¹)         | 12.34       |
| Organic matter %                  | 0.54        |

Well water used for irrigation before mitigation

| E-level of electrical conduction of water (E.C) | 6.86 d S.m⁻¹ |
| PH                                              | 7.16         |

Results and discussion

The effect of salinity levels of irrigation water and varieties in the indicators of the yield of the potato

1- Weight of one tuber (g . plant⁻¹)

The results of the table (2) showed that the varieties under study had a significant effect in the characteristic of the weight of the tuber per plant (g), V1 cultivar significant effect in recording the highest rate (71.97) g while the V4 cultivar recorded the lowest rate for this characteristic, as for Water salinity levels of irrigation water it was noted S1 for irrigation water gave the highest rate of the characteristic (76.22) g and S4 water irrigation gave lowest rate of the weight of the tuber (55.32 g), the interaction table (3) V1 * S1 gave the highest rate of this characteristic (85.92) g while V4 * S4, gave the lowest rate of the weight of the tuber (52.49) g. These results were in agreement with (15), where it was found that the weight of one tuber decreases by increasing the concentration of salts in irrigation water, in order to the negative effect of salts on various events in the plant and thus to affect the weight of the tuber.

2- Number of tubers in the plant (tuber. plant⁻¹)

It is clear from table (2) that the factor of the item has a significant effect on the character of the number of tubers. Plant⁻¹, V1, V2 plants have high significant the rest of the varieties studied and averaged (5.53, 5.44) tubers. Plant⁻¹ while the plants V3, V4 gave the lowest number of tubers. Plant⁻¹ (5.03, 4.86) tuber. Plant⁻¹, it is clear from the results of the table (2) that the levels of salinity of irrigation water differed effect among themselves, S1 gave the highest number of tubers. Plant⁻¹ (6.02) while S4 gave the lower number of tubers (4.49)
tubers. Plant\(^{-1}\), as for the interaction, it is noted from the table (3) that the plants of varieties (V1, V2, V5) and irrigated water \(*\) S1 have significant effect they gave highest number of tubers. Plant\(^{-1}\) (6.35, 6.21, 6.11) tuber. Plant\(^{-1}\) respectively, V4 \(*\) S4 GAVE lowest number of tubers. Plant\(^{-1}\) (4.20) tuber. Plant\(^{-1}\). This result was agreed with (10) as the increase in salt water in irrigation water has affected the number of tubers/plants.

3- The yield per plant (g.plant\(^{-1}\))

The results of table (2) showed that the single factors had a significant effect on the characteristic yield of plant (g. plant\(^{-1}\)), where V1 gave the highest rate of this characteristic (397.80) g. Plant\(^{-1}\), while the plants V4 gave the lowest rate of the characteristic of yield of plant (298.90) g. Plant\(^{-1}\), it is noted from the same table that watering with water s1 gave the highest rate for this characteristic (461.30) g. Plant\(^{-1}\), while irrigation water with s4 recorded the lowest rate per plant yield (248.70) g. Plant\(^{-1}\). The results of the table (3) for interaction showed that the plants of the (V1* S1) gave the highest rate of this characteristic (546.10) g. Plant\(^{-1}\), while (V3,V4) S4 gave the lowest weight per plant yield (235.90, 220.40 g). Plant\(^{-1}\).

4- Marketing yield (ton. Donem\(^{-1}\))

The results of the table (2) showed that the items under study had significant effect on the status of the marketing yield (ton / don. \()\), V1 give the highest rate (3.61) ton. Don\(^{-1}\), While the V3 recorded the lowest rate for this characteristic. As for the salinity levels of irrigation water, it was noted that S1 gave the highest rate (4.72) tons.Don\(^{-1}\) and S4 gave the lowest rate of marketing yield (2.23) tons. table (3) , the interaction V1* S1 gave the highest rate of this characteristic (5.00) tons. Don\(^{-1}\), while V4* S4 gave the lowest rate of weight per tuber (2.05) tons. Don\(^{-1}\).

5- Total yield (ton. Donem\(^{-1}\))

table (2) showed that the plants of the varieties studied differed among them in the characteristic of the total yield (ton. Don\(^{-1}\)), V1 have significant effect while V3 , V4 gave the lowest rate of this characteristic and without difference of each other reached (2.99, 2.92) ton. As for the salinity levels of irrigation water, the results of the same table showed S1 gave the highest rate (4.51) tons. Don\(^{-1}\) the s4 gave lowest rate of total yield (2.43) ton. Table (3) the interaction between varieties and irrigation water salinity levels, V1 * S1 recorded the highest rate (5.34) tons.Don\(^{-1}\), while (V3 , V4 ) * S4 the lowest rate of the total yield (2.30, 2.15 ) tons). Don\(^{-1}\). With regard to the effect of varieties in the quantitative qualities (yield and its components) may be due to the difference and disparity between them due to their difference in vegetative qualities, as the good vegetative total will provide a rich food source for tubers and thus this is reflected on the composition of tubers with good qualities in terms of quantity and type and this is consistent with what reached (5, 19). The indicators related to the yield and its components are one of the most important determinants of the nutritional and economic value of the crop of potato plant, which consists of the influence of several factors, the most important of which are the environmental conditions prevailing during the cultivation of plants and the quality of irrigation water during the period of growth and the disparity between varieties in their genetic characteristics, which is reflected in their variation in its morphological qualities and the strength of the vegetative parts of the plant, which have affected the efficiency
of the carbon representation process and thus the manufacture of a larger amount of carbohydrates that accumulate in the storage and consumption areas of tubers (8).

The effect of irrigation water salinity levels and varieties in some specific qualities of tubers

1- Percentage of dry matter for tubers (%)

Table (2) shows that the varieties and salinity levels of irrigation water have different effect on the character of the percentage of dry matter of tubers (%) as it is noted that (V1, V2), They did not differ from each other in % dry matter, with their respective rates (17.61, 17.48%) while (V3, V4) gave lower rates for this characteristic (16.51, 16.63%). It was also noted that S1 gave highest rate (19.00) %, and S4 recorded the lowest percentage of dry matter in tubers (15.47%), the interaction V1 * S1 gave the highest rate of dry matter (20.00%) and V3 * S4 the lowest rate of this characteristic (15.23)%.

2- Percentage of starch in tubers (%)

It is clear from table (2) that the factor of the cultivar has a different effect in the character of the percentage of starch in tubers, V1, V2 have significant effect the rest of the items studied and their average (11.82, 11.57) and without difference from each other. While V3, V4 the lowest percentage of starch (10.72, 10.77) %, and the results of the same table show that the salinity levels of irrigation water differed means among them, S1 gave the highest rate of this characteristic (12.92) % while S4 lowest rate (9.90) %, as for the interaction table (3), note v1, v2 recorded the highest percentage of starch in tubers (13.67, 13.83%), and (v3, v4)* s4 gave the lowest percentage of the starch (9.66, 9.49%).

These results are consistent with his mention (1) that the varieties differed among themselves in the specific qualities and may be due to the different genetic traits of the varieties, which affected the percentage of dry matter, which in turn affected the percentage of the population.

Conclusions: We draw from the results of this study that the two cultivars V1, V2 showed high significant effect in most of the qualities studied under the conditions of the experiment, and that the higher the salinity levels in irrigation water negatively affected the yield and its ingredients for potatoes, and can be used from these results to choose the most tolerant and stable varieties under saline stress.

Table (2) effect of salinity levels, varieties in the characteristics

| Cultivar | Weight of one tuber (g) | No. of tubers (tuber/plant) | Yield per plant (g/plant) | Marketable yield (ton/plant) | Total yield (ton/Don) | % dry matter for tuber (%) | % starch (%) |
|----------|------------------------|-----------------------------|---------------------------|----------------------------|-----------------------|----------------------------|-------------|
| V1       | 71.79                  | 5.44                        | 397.80                    | 3.61                       | 3.89                  | 17.48                      | 11.57       |
| V2       | 67.74                  | 5.53                        | 381.10                    | 3.45                       | 3.73                  | 17.61                      | 11.82       |
| Cultivars | Levels of Salinity d s.m⁻¹ | Weight of one tuber (g) | No. of tubers (tuber/plant) | Yield per plant (g/plant) | Marketing yield (ton/don.) | Total yield (ton. Don.) | % dry matter for tuber (%) | % starch (%) |
|----------|-----------------------------|-------------------------|-----------------------------|--------------------------|---------------------------|------------------------|---------------------------|-------------|
| BUREN    | S1  82.92                   | 6.35                    | 546.10                      | 5.00                     | 5.34                      | 19.88                  | 13.66                     |
|          | S2  75.78                   | 5.68                    | 430.37                      | 3.91                     | 4.20                      | 17.94                  | 12.00                     |
|          | S3  64.73                   | 5.04                    | 326.41                      | 3.01                     | 3.19                      | 16.49                  | 10.70                     |
|          | S4  61.42                   | 4.69                    | 288.12                      | 2.52                     | 2.81                      | 15.58                  | 9.89                      |
| RIVERA   | S1  84.09                   | 6.11                    | 513.79                      | 4.67                     | 5.02                      | 20.00                  | 13.82                     |
|          | S2  73.56                   | 5.97                    | 439.80                      | 4.03                     | 4.30                      | 18.19                  | 12.05                     |
|          | S3  62.40                   | 5.13                    | 320.51                      | 2.76                     | 3.13                      | 16.60                  | 10.79                     |
|          | S4  50.90                   | 4.90                    | 250.09                      | 2.32                     | 2.45                      | 15.65                  | 10.61                     |
| FANDANGO | S1  67.31                   | 5.61                    | 377.50                      | 2.91                     | 3.68                      | 18.02                  | 12.60                     |
|          | S2  62.07                   | 4.87                    | 302.68                      | 2.62                     | 2.95                      | 17.24                  | 11.20                     |
|          | S3  60.66                   | 4.61                    | 279.56                      | 2.37                     | 2.73                      | 16.04                  | 10.30                     |
|          | S4  54.25                   | 4.34                    | 235.93                      | 2.16                     | 2.30                      | 15.23                  | 9.48                      |
| VOUGE    | S1  65.60                   | 5.85                    | 383.77                      | 3.32                     | 3.75                      | 18.00                  | 12.04                     |
|          | S2  63.06                   | 5.28                    | 333.20                      | 3.01                     | 3.26                      | 16.67                  | 10.86                     |
|          | S3  54.49                   | 4.80                    | 286.79                      | 2.45                     | 2.80                      | 16.04                  | 10.30                     |
|          | S4  52.49                   | 4.20                    | 220.43                      | 2.05                     | 2.15                      | 15.33                  | 9.66                      |
| AREZONA  | S1  78.14                   | 6.21                    | 485.18                      | 4.44                     | 4.77                      | 19.08                  | 13.00                     |
|          | S2  68.04                   | 5.47                    | 372.13                      | 3.22                     | 3.63                      | 17.92                  | 11.97                     |
|          | S3  62.32                   | 4.60                    | 290.70                      | 2.22                     | 2.84                      | 16.45                  | 10.66                     |
|          | S4  57.54                   | 4.33                    | 249.16                      | 2.09                     | 2.43                      | 15.55                  | 9.86                      |
| L. S. D. (0.05) | 2.57                   | 0.34                    | 24.19                      | 0.35                     | 0.24                      | 0.30                   | 0.54                      |

Table (3) effect the interaction between salinity levels and varieties in the characteristics.
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