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The impact of *Saccharomyces cerevisiae* stimulation on various physiological indicators of oats (*Avena sativa*) exposed to salinity

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Abstract. *Abdulfatah HF, Naji EF. 2023. The impact of* Saccharomyces cerevisiae *stimulation on various physiological indicators of oats (*Avena sativa*) exposed to salinity. Biodiversitas 24: 6753-6759.* The objective of the current study is to examine the effects of different levels of salinity, specifically 0, 2.5, and 4.5 ds m^{-1}(S1, S2, S3), on diverse physiological parameters in two principal oat cultivars (*Avena sativa* L.), Pimula (A1), and Genzania (A2), priming with *Saccharomyces cerevisiae* for 24 hours at a concentration of 0 and 6 $g.L^{-1}$. The study employed a completely randomized design with three repetitions for each treatment and was conducted at the laboratory of the College of Science, University of Anbar. The Genzania cultivar that was not stimulated with yeast demonstrated the highest percentage of total chlorophyll content (2.28 mg. g. $plant^{-1}$), statistically significant ($P \leq 0.05$) compared to the lowest rate recorded by the Pimula cultivar (1.94 mg. g. $plant^{-1}$). While no significant differences appeared between both cultivars stimulated with yeast under the influence of the salinity concentrations, the S2 treatment had the highest rate and significantly more than the S3 treatment. This demonstrates increased tolerance of the yeast priming cultivars to salinity treatment. The A2 cultivar was characterized by the highest rate of proline in plants stimulated and not stimulated with yeast, with significant differences from the A1 cultivar. However, the S3 treatment had the highest rate of proline (20.96µmole g $plant^{-1}$) in the stimulated plants, with a higher significance than treatment S2. There was a statistically significant in the electrolyte leakage rate between the non-stimulated cultivars. In contrast, no significant differences appeared for the plants stimulated with yeast, indicating an increase in their tolerance to salinity. Priming seeds with yeast extract has been shown to improve important physiological characteristics in plants, such as total chlorophyll content, proline content, and electrolyte leakage, indicating the effectiveness of yeast in increasing plant resilience to salt stress.

Keywords: Oat, RWC, salinity, seeds priming, yeast

INTRODUCTION

An annual grass, oat (*Avena sativa* L.), that belongs to the Poaceae family, one of the most commercially and ecologically important groups in the world. Although oat may grow in soil with a pH as low as 4.5, it usually grows at a pH between 5.3 and 5.7 (Ovando-Martínez et al. 2013). Because it is an economically important nutrient, they are the most commonly cultivated plant that is regarded as a healthy food. Additionally, it is used externally to treat dry skin and eczema. Today, it is used for hay, pasture, green manure, or as a cover crop, which increases the organic component, improves the soil's life, and prevents weeds and erosion. In recent years, there have been studies on different types of oats and their ability to withstand varying levels of salinity as well as alkalinity in plants. Bai (2018) researched and found that concentrations of 68.5 mmol L^{-1} salt and 22.5 mmol L^{-1} alkali were suitable for assessing oat tolerance to salinity and alkalinity during germination.

In dry environments, salinity is a major environmental stressor that limits agricultural productivity by reducing the germination rate, delaying the germination process, and delaying the emergence of seedlings (Uçarlı 2020). The salinity problem affects around the earth's surface; 33% of irrigated land and 20% of the world's agricultural land are damaged by salt. It is also assumed to be involved in the destruction of 10 million hectares of agricultural land annually. Weather variations, tainted irrigation water, extensive farming, and insufficient drainage can all cause this rate to increase (Zia et al. 2017). Impacts of salt stress on plants include inhibition of certain enzyme activities, lead to changes in the metabolism of vital amino acids, proteins, lipids, reduction in photosynthetic rates, and a delay in plant growth and development by excessive build-up of harmful ions, specifically Na^+ and Cl^- (El Moukhtari et al. 2020; Gupta and Seth 2020). Due to the high osmotic pressure caused by these soluble salt concentrations, plants are unable to absorb as much water as they need, which reduces crop productivity in the influenced lands.

According to Paparella et al. (2015), the process of priming involves the controlled hydration of seeds before germination, wherein the seeds are exposed to eliciting factors at an early developmental stage to induce mild levels of stress that enhance the stress tolerance potential of plants. This process also boosts the plants' ability to adapt to subsequent stresses. Seed priming or hardening also induces short-term and long-term memory that strengthens the plants, thus improving their adaptability when exposed to subsequent stresses, as noted by Thakur et al. (2020). This environmentally conscious approach additionally stimulates signaling molecules, thereby augmenting plants' inherent capacity for salt tolerance, which is instrumental

in their recuperation from the damages caused by salt exposure (Guo et al. 2022).

The early stages of germination are triggered by this limited hydration strategy before radicular protrusion. After priming in special solutions containing Phytohormone priming such as Gibberellic acid (GA3), Absesic acid(ABA)-catabolizing enzymes, Indole-3-acetic acid or auxin (IAA), Salicylic acid (SA), Brassinosteroids (BRs), Jasmonic acid (JA); antioxidants ascorbic acid, H_2O_2, glutathione, and tocopherone; organic solutes such as proline and Melatonin; Osmopriming such as polyethylene glycol (PEG), Mannitol; and biopriming such as som species of bacteria and fungi for a predetermined amount of time to permit germination metabolic pathways, seeds are then dried to inhibit the occurrence of radicle protrusion (Biswas et al. 2023). These microorganisms possess the capacity to transform significant nutrient elements such as nitrogen, phosphorus, and potassium (NPK) from an unavailable to an available state through biological processes (Silva et al. 2023). Bread yeasts are microscopic, single-celled eukaryotic organisms that propagate via simple division or budding. Yeast is capable of promoting the absorption of essential nutrients, including nitrogen(N), Phosphorus (P), and Potassium (K), required for plant growth. In addition, yeast can produce phytohormones such as Indole-3-acetic acid (IAA) and cytokinins, which are organic compounds, as well as amino acids and vitamins (particularly B complex), that promote growth through facilitated cell division and growth, ultimately leading to an improvement in plant growth and productivity (Hernández-Fernández et al. 2021).

The objective of the current investigation was to increase the resilience of oat seeds to saline stress by immersing them in bread yeast extract and subjecting them to salinity stress conditions. Moreover, the investigation also sought to examine the impact of varying levels of salinity on the growth of two distinct oat plant types.

MATERIAL AND METHODS

Plant materials and seeds treatment

The experiment was carried out in the College of Science's laboratory at the University of Anbar, Iraq during December 2022. The plant materials included two oat varieties: Pimula (A1) and Genzania (A2), which were obtained from the Center for Desert Studies at the University of Anbar.

Seeds sterilization was performed by sodium hypochlorite solution (10%) for 1-2 min, then washed twice with sterile D.W and dried with filter paper. Seeds were soaked with the prepared bread yeast at a concentration 0 and 6 g $.L^{-1}$ for 24 hours.

Prepare yeast extract

The yeast extract was digested by dissolving 0.5 g of sugar in 1 liter of distilled water (30° C). Dry yeast was added to the aforementioned weight to achieve the necessary concentration after the mixture had been agitated to ensure that the sucrose had been dissolved. These solutions were incubated at 30° C for 4 hours before being filtered to create the necessary solution, in which the seeds were then soaked for 24 hours while continuing to incubate at 25° C. The seeds were then air-dried for 24 hours at room temperature.

Soil preparation and growth conditions

Five pits for each pot were made. Each pit was planted with two oat seeds in pots containing 1 kg of the river soil the physicochemical properties of this soil are shown in Table 1, which was mixed with peat moss in a 5:1 ratio. The two oat genotypes underwent three applications of salinity treatments (0, 2.5, and 4.5 $ds.m^{-1}$) using NaCl and were labeled sequentially as S1, S2, and S3. After germination, the seedlings were thinned, and the strongest one was kept in each pit. The plants were irrigated with the prepared saline solutions for each treatment, which began 21 days after sowing and continued until reaching the maturity stage. Saline water (NaCl) of the EC level corresponding to each treatment was applied to the plants daily in the morning to a field capacity until a leaching fraction of 20% was reached, while the control plants were watered with distilled water. Plant samples were gathered in the vegetative development stage to evaluate the physiological parameters (after 53 days from planting).

Table 1. Physicochemical characteristics of the river soil used in the current study

Total N (%)		**Density gm.cm^{-1}**	**Mutual K mg.kg^{-1}**		**pH**	**Ready P gm.kg^{-1}**	**O.M. (%)**	**ECμs**
0.42		1.55	128.04		7.37	2.12	1.38	1059
Dissolved positive and negative ions ml.eq.L^{-1}								Soil texture
Cl^-	$SO_4^=$	$HCO_3^=$	$CO_3^=$	K^+	Ca^{++}	Mg^{++}	Na^+	Sandy loam
4.42	9.68	3.40	Nile	5.92	12.4	3.60	0.68	
Soil compounds			Silt		Sand		Clay	
			268		660		72	

Note: The analysis was carried out at the laboratories of the Agriculture College, University of Anbar, Iraq

Statistics

Three replicates of each treatment were used in the completely randomized design (CRD) of the experiment. Gen Stat 12th Edition was used to examine the data.

Physiological estimates

Total chlorophyll and carotenoids content

The three replicates for each treatment's 0.2 g of freshly expanded leaf were harvested throughout the vegetative growth stages. Total chlorophyll content and carotenoids were estimated according to Witham et al. (1971) for chlorophyll and Lichtenthaler (1987) for total carotenoids. Under cover of darkness, samples of the leaf were quickly homogenized in 10 mL of 80% acetone. At 645, 663, and 470 nm wavelengths, absorption was detected. Using the following formulae, total chlorophyll (Ch.a+Ch.b)and carotenoids was measured and calculated in milligrams per each gram of fresh weight:

Total chlorophyll = chlorophyll a+ chlorophyll b

Chlorophyll a (mg /g tissue) = 12.7(D663)-2.69(D645) *(V/1000*W)

Chlorophyll b (mg /g tissue) = 22.9(D645)-4.68(D663) *(V/1000*W)

Carotenoids (mg /g tissue) = 1000 (D470) - 1.82 chlorophyll a - 85.02 chlorophyll b /198

V= Volume of acetone, W= Weight of leaf samples

Proline content

Estimate the proline according to Bates et al. (1973). A fully mature leaf weighing 0.2 g was collected from a particular region and homogenized in 10 mL of 3% sulphosalicylic acid w/v. After centrifuging the extract for 10 minutes at 10,000 rpm, 2 mL of the ninhydrin acid reagent were added "1.25 g of ninhydrin dissolved with 30 mL of glacial acetic acid and 20 mL of 6 M of orthophosphoric acid heat the mixture for several minutes till the ninhydrin is fully dissolved". Supernatant, 2 mL, was added. After one hour in a 100° C water bath, the contents were quickly chilled in an ice bath. The intensity of the pink color was measured at 520 nm after each sample had cooled and 4 mL of toluene had been added. Toluene was used as a blank to produce a standard pure proline curve (0.1 mg. mL^{-1}) with varying amounts of proline. Using a standard curve and a fresh weight, the proline content of plant matter was approximated as follows:

proline (µmoles /g)= [(µg proline/ mL × mL toluene) /115.5 µg / µmoles]/[(g sample)/5].

Relative Water Content (RWC)

Depending on turgid (TW), fresh (FW), and dry (DW) weights, the relative water content of the leaves was calculated as a measure of the water content of the leaves at vegetative development stage according Patanè et al. (2022). The completely formed apical leaf was cut, and its fresh weight was determined by weighing it immediately after. Falcon tubes were used to store the leaves (10 mL). Each tube received two mL of distilled water before being placed in the refrigerator for 24 hours at 4° C. After blotting the leaves using tissue paper to remove any remaining moisture, they were immediately weighed to determine their turgid weight. The turgid leaves were dried for 48 hours at 65° C in an oven. The dried leaves were weighed and the weight was given in grams per leaf. RWC was determined according to the formula: RWC%= (FW-DW)/ (TW-DW) ×100.

Electrolyte leakage

According to Alyammahi and Gururani (2020), the membrane stability index (MSI) or electrolyte leakage was determined from a fully developed leaf obtained from a particular location at the vegetative development stage. The leaf samples were divided into six equal disks and submerged for 12 hours in 10 mL of distilled water. To evaluate electrolyte leakage, the leaf disks were put in a test tube with 10 mL of distilled water. After that, the leaf disks were boiled. The filtrate's electrical conductivity (ECa) was then measured with an EC meter (Trans-BC3020, China). The electrical conductivity (ECb) was measured once again after heating the filtrate to 55° C for 30 minutes. The electrical conductivity (ECc) was then determined after the filtrate had been heated again for 10 minutes at 100° C.

The electrolyte leakage was calculated using:

MSI (%) = (ECb-ECa/ECc) × 100

RESULTS AND DISCUSSION

Total chlorophyll content

The findings in Table 2 demonstrate the superiority of the Genzania cultivar that is not stimulated by yeast in terms of total chlorophyll ratio, when compared to the minimum rate of 1.94 mg. g $plant^{-1}$ observed in cultivar A1 (Pimula). The application of saline treatments S2 and S3 led to insignificant variances in comparison to the control treatment (2.29 mg. g $plant^{-1}$). Nevertheless, discernible disparities were not observed among identical cultivars that were subjected to yeast stimulation, indicating an augmentation in salt stress tolerance. Treatments S3 were observed to have a negative impact, as evidenced by the lowest rate of total chlorophyll content. Specifically, the value 2.01 mg. g $plant^{-1}$ were noted as being significantly lower than the control and S2 values of 2.47 and 2.39 mg. g $plant^{-1}$.In general, plants treated with yeast showed the highest grand mean of total chlorophyll content, (2.29 mg. g $plant^{-1}$) this result demonstrated a clear superiority than untreated plants.

Total carotenoids content

The carotenoid concentrations in the plant samples are depicted in Table 2, indicating no notable statistical difference between oat varieties A1 and A2 for non-priming plants. No significant differences were observed among the three salt treatments concerning the carotenoid

rate, as is evident from the previously mentioned table. Moreover, no significant variations in carotenoid levels were observed in the yeast-treated cultivars, with respective values of 7.22 and 7.46 mg. g plant^{-1}. Similarly, in the case of saline treatments, no significant differences were observed between them. The grand mean results indicate a considerable discrepancy in the content of carotenoids detected in the plants that were induced with yeast in comparison to the ones that were not stimulated.

Proline content

The results of Table 2 for the plants not soaked with yeast indicate the clear superiority of the Genzania cultivar, with the rate of proline under the influence of different salt concentrations was 25 µmole.g plant^{-1}, with a positive increase compared to the cultivar Pimula (A1), which recorded a rate of 14.5 µmole.g plant^{-1}. In contrast, the saline treatments S2 and S3 recorded apparent significant differences compared to the control, with rates of 14.9 and 16.5 µmole.g plant^{-1}, Respectively. As for the plants stimulated with bread yeast, the same variety A2 outperformed it positively and recorded 20.40 µmole.g plant^{-1} with significant differences compared to the variety A1 (16.41 µmole.g plant^{-1}). For the salt treatments, proline rates were negatively affected in treatment S2, with significant differences compared to the control treatment and treatment S3, which did not record significant differences between them, at rates of 22.42 and 20.96 µmole.g plant^{-1}, respectively. The grand mean of the stimulated plants indicates that the level of proline decreased in comparison to the non-stimulated plants.

Relative Water Content (RWC)

Table 2 did not show any significant differences among the untreated oat cultivars with yeast when exposed to varying salt concentrations. However, the control treatment and treatment S2 had higher rates compared to treatment S3, which had a rate of 81.43% lowest rates were observed in the relative water content. Although there were no significant variations in oat cultivars when plants were primed with yeast, treatment S2 displayed exceptional performance in terms of relative water content (RWC) with no significant disparities compared to the control (82.78%). However, when compared to treatment S3, which had the lowest rates and recorded a value of 77.53%, treatment S2 was found to be statistically significant. It is clear from the Grand mean that the rate of RWC more decreased in stimulated plants (81.01%) than in non-stimulated plants.

Electrolyte leakage (MSI)

Table 2 highlights the distinguishing feature of the Pimula cultivar in non-stimulated plants, which showed a significant rise in membrane stability index (MSI) as compared to the more saline treatment tolerant Genzania cultivar (56.4%). The treatment with S3 saline was observed to have the highest level of electrolyte leakage, specifically 65.1%, as compared to the control treatment, which recorded 55.4%. With regards to the plants that were exposed to yeast stimulation, there was no significant difference detected between the two cultivars. Nevertheless, the S3 treatment demonstrated the highest level of electrolyte leakage, at 75.6%, in comparison to the S1 and S2 treatments, which recorded 60.4 and 52.3%, respectively. The grand mean indicates that the stimulated plants displayed the highest rates of EL in comparison to the non-stimulated plants, which had a grand mean of 60.1%.

Discussion

Abiotic stresses, such as salinity, heavy metals, insufficient or excessive water, ultraviolet radiation and low or high temperature, have a negative impact on the growth and development of plants (Zhu et al. 2021). Salinity not only has an adverse effect on leaf size and number, but also impedes the growth of tillers, stems, and the overall plant dry weight (Ibrahim 2016). Therefore, it is crucial to enhance crop salt tolerance in order to exploit saline lands. An effective strategy for mitigating the harmful effects of abiotic stress is through the use of seed priming techniques (Chen and Arora 2011; Yadav et al. 2011). In this study, we explored the mitigating effects of seed priming with bread yeast on two oat cultivars that were subjected to salt stress. The findings are consistent with the research of Acosta-Motos et al. (2017), which investigated that plants tolerant to NaCl undergo a number of morphological, physiological, and biochemical changes to adjust to salt. Chlorophyll content has increased as a result of these changes. In contrast, the investigation of the deterioration of photosynthetic pigments was conducted by Sayyad-Amin et al. (2016). The study examined the correlation between the modification in the lipid-protein ratio of pigment-protein complexes and the increase in chlorophyllase activity with increasing of salt concentrations. This elucidates the proposed impact of salt stress on photosynthesis processes and its effect on plant growth. However, this phenomenon also results in the restriction of CO_2 uptake, which subsequently diminishes the rate of photosynthesis, and limits plant growth and production. Thus, it has been demonstrated that a number of strategies, including as seed priming, seed treatment, and screening of different genotypes, can improve germination and germination qualities under high salt conditions (Jiang et al. 2020). Shumaila et al. (2023) demonstrated an enhancement in the morpho-anatomical and physiological responses of *Solanum melongena* L. under salinity stress conditions by utilizing cost-effective and readily accessible biochar and seed priming with Gallic Acid. Moreover, the external absorption of free amino acids provided advantageous characteristics, such as enhancing photosynthesis, synthesizing coenzymes, and aiding botanical organisms in coping with environmental stress (Amin et al. 2011). The previously mentioned methodology has been utilized to cultivate the main varieties of vegetable crops, specifically carrots, onion, celery, lettuce, pepper, and tomato (Valivand et al. 2019).

Table 2. Total chlorophyll content (mg.g plant^{-1}) for oat varieties that treated with different concentrations of salt and yeast

Yeast extract con.	**0 g.L^{-1}**				**6 g.L^{-1}**			
Salt con. / Variety name	**S1 0 ds.m^{-1}**	**S2 2.5 ds.m^{-1}**	**S3 4.5 ds.m^{-1}**	**Average**	**S1 0 ds.m^{-1}**	**S2 2.5 ds.m^{-1}**	**S3 4.5 ds.m^{-1}**	**Average**
Total chlorophyll (mg.g plant^{-1})								
A1 (Pimula)	2.07	1.87	1.88	1.94	2.59	2.31	2.26	2.39
A2 (Genzania)	2.51	2.31	2.03	2.28	2.36	2.46	1.75	2.19
LSD P≤0.05		0.53		0.30		0.62		0.35
Average	2.29	2.09	1.95	Grand mean	2.47	2.39	2.01	Grand mean
LSD P≤0.05		0.37		2.11		0.44		2.29
Carotenoids (mg.g plant^{-1})								
A1 (Pimula)	7.13	6.43	6.38	6.64	6.32	7.65	7.69	7.22
A2 (Genzania)	7.78	6.98	7.75	7.50	7.91	8.07	6.39	7.46
LSD P≤0.05	1.74	1.01	1.28	0.73				
Average	7.45	6.71	7.06	Grand mean	7.12	7.86	7.04	Grand mean
LSD P≤0.05	1.23	7.07	0.90	7.34				
Proline (µmole.g plant^{-1})								
A1 (Pimula)	27.9	9.4	6.3	14.5	18.41	12.73	18.09	16.41
A2 (Genzania)	27.9	20.4	26.6	25.0	26.42	10.96	23.82	20.40
LSD P≤0.05	14.03	8.10	6.26	3.61				
Average	27.9	14.9	16.5	Grand mean	22.42	11.84	20.96	Grand mean
LSD P≤0.05	9.92	19.8	4.42	18.41				
RWC (%)								
A1 (Pimula)	86.50	86.00	81.20	84.57	83.96	80.75	78.88	81.20
A2 (Genzania)	87.33	86.23	81.66	85.07	81.59	84.68	76.18	80.82
LSD P≤0.05	2.08	1.20	6.20	3.58				
Average	86.92	86.12	81.43	Grand mean	82.78	82.72	77.53	Grand mean
LSD P≤0.05	1.47	84.82	4.38	81.01				
EL(%)								
A1 (Pimula)	49.7	64.8	77.0	63.8	45.8	52.8	78.5	59.0
A2 (Genzania)	61.0	55.0	53.3	56.4	75.1	51.8	72.8	66.5
LSD P≤0.05	11.69	6.75	15.69	9.06				
Average	55.4	59.9	65.1	Grand mean	60.4	52.3	75.6	Grand mean
LSD P≤0.05	8.27	60.1	11.09	62.8				

Salinity stress has adverse effects on plant growth due to the reduction in photosynthesis caused by the elevation in salinity levels. As a result, salt stress has detrimental effects on the growth of plants. Reactive Oxygen Species (ROS) are produced as a result of the electron transport chain during plant photosynthesis. The elevated salinity levels induce the production of multiple Reactive Oxygen Species (ROS), which in turn stimulate the accumulation of secondary metabolites to counteract the ROS. Carotenoids are crucial secondary metabolites that effectively suppress ROS, playing a significant role in the process of plant salt tolerance (Ding et al. 2023). In plants, carotenoids have diverse functions related to photosynthesis and photo-protection, and they function as precursors of phytohormones. Carotenoids serve as potent antioxidants in various biological systems due to their ability to react with free radicals. They also exhibit strong activity against singlet oxygen generated from lipid peroxidation or radiation (Kazimierczak et al. 2020). High salinity significantly impedes photosynthesis, particularly in the photosystem II (PSII) complex. The presence of salinity stress leads to a reduction in PSII activity and hinders the quantum yield of PSII electron transport (Xia et al. 2004). The specific location within PSII affected by high salt concentrations seems to differ among species (Backhausen et al. 2005). However, Misra et al. (2001) have documented that NaCl salinity impacts the PSII photochemical efficiency, primary charge separation in PSII, and pigment-protein complexes of thylakoid membranes. The impact of stress induced by salinity on pigment composition, specifically the overall concentration of chlorophyll and carotenoids, may be attributed to the harmful effects of salt, which interfere with the genes responsible for chlorophyll production and structure. As a result, there is a decrease in pigment activity. Leiva-Ampuero et al. (2020) investigated whether the expression of PSY1, PDS, ZDS, and LYCB, key genes in the carotenoid biosynthesis pathway, was increased in mature green tomatoes due to the influence of salt. Higher levels of lycopene, lutein, β-carotene, and violaxanthin accompanied this increase in gene expression. These findings suggest a strong relationship between the response of photosynthetic plants and their yield. This connection involves a decrease in photosynthetic capacity and an increase in the expression of genes related to carotenoid

production. Furthermore, the increase in transpiration results in water loss from seedlings and a reduction in nutrient levels needed, leading to a decrease in the osmotic potential of nutrients and the suppression of development, as well as the formation of pigments essential for photosynthetic activity (Ding et al. 2023).

Due to its capacity to neutralize ROS, stabilize proteins, DNA, and other biological macromolecules, and provide cellular redox potential, proline has been regarded as a molecular chaperone (Rejeb et al. 2014). While NAD(P)H is necessary for proline biosynthesis to prevent ROS formation, CO_2 generated under stressful conditions facilitates carbon reduction (Signorelli et al. 2015). Furthermore, proline has been demonstrated to maintain RuBisCo activity and the complex II electron transport chain in mitochondria, both of which contribute to improved photosynthesis (El Moukhtari et al. 2020). Moreover, this is particularly relevant in instances of osmotic stress, as proline anabolism enables plants to modify their osmotic homeostasis and assists them in replenishing their water content (El Moukhtari et al. 2020).

A high leaf RWC can serve as an effective indicator of membrane stability and integrity under saline stress. The decline in RWC may be attributed to the reduction in water intake and/or its detrimental impact on the composition of cell walls, as noted in previous research (Parvin et al. 2020). It is plausible that the reason for the high ability of salt-tolerant genotypes to absorb water is due to their natural capacity to store water under salinity stress, ultimately preventing tissue dryness. Evidently, salt stress significantly impacts yield and its properties such as panicle length, seed yield per pot, and 100-seed weight, during the maturity stage. The aforementioned phenomenon is attributed to the imposition of salinity stress, which leads to the manifestation of nutritional discrepancies, changes in the relative water content, photosynthetic activity, assimilate distribution, ion transportation, and the reproductive phase. The confluence of these factors ultimately reduces both the quantity and quality of the yield, as evidenced in citation (El Sabagh et al. 2020).

In this study, the issue of ion leakage was encountered as a result of the elevated permeability of the membranes. This is consistent with the observations made by Alharby et al. (2019), wherein it was determined that salt stress negatively impacts plants, leading to an increase in the percentage of electrolyte leakage. Such an outcome could potentially be attributed to the deleterious effects on the plasma membrane and its selective permeability, ultimately resulting in an elevation of EL. As Gupta and Seth (2023) improved the mitigation of salinity stress was accomplished by decreasing nuclear damage and cell death while simultaneously enhancing the stability of the cell membranes and the accumulation of nutrients.

In conclusion, it is evident that ionic imbalance brought on by salt reduces metabolic activity, cell division, and growth. Seed priming may involve soaking the seeds in bread yeast extract, which increases pigment concentration, chlorophyll and carotenoid content, increasing plant productivity by increasing metabolic activity. It has been demonstrated that salt stress has a damaging effect on seed germination and seedling development, which are known to be more delicate stages for most crops. Moreover, soaking the yeast may increase levels of proline, one of the antioxidants, enhancing the plant's resistance to the stress of salt exposure. Increasing the rate of EL was affected by the saline treatment's effects on the stability of the membrane. From the outcomes acquired, it is evident that the process of soaking the cultivars with yeast resulted in an enhancement of their resistance towards salt stress. Additionally, this approach demonstrated a favorable impact on the majority of their physiological characteristics.

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