A REVIEW ON SALT INDUCED STRESS IN RICE *(Oryza sativa* L.*)* PLANT AND IT'S EFFECT ON GROWTH AND METABOLISM

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Abstract: **Salinity is a significant barrier to the production of grains worldwide, particularly rice and wheat. A potential solution to the problem of soil salinity and the rising food demand is the discovery and enhancement of salt-tolerant rice based on genetic diversity and salt stress response. Plant reactions to salt stress take place at the molecular, cellular, and organismic levels. A lot of work has been done over the last few decades to develop cultivars that can withstand salt using conventional methods and sophisticated molecular tools and procedures. In many nations aroundthe world, rice (*Oryza sativa* L.) is the main crop grown for food. Salinity inhibits the growth of roots and shoots, while additional partially reverses this effect. Reduced tillers and sterile spikelets are the main causes of low yields of rice in some cultivars. Understanding the precise way that rice reacts to ion accumulation at the hazardous level can help identify the main causesof limited growth and delayed development of rice production in the future.**

Keywords: **Rice, salinity stress, phytohormones, NaCl, osmoprotectant**

INTRODUCTION:

Plant crop faces a major issue due to environmental factors which as the salinity of the soil. Changes in enzymes are witnessed due to excess environmental stress in developing plants withhigh salt concentrations thus leading to the limiting of plant growth. Rice (*Oryza sativa* L.) is exceptionally prone to the rhizosphere salinity than different cereals. High susceptibility has been observed, particularly at vegetative and reproductive degrees in rice[1]. Tim Flowers (2006) emphasized that "Salinity has been a risk to agriculture in a few elementsof the arena for over 3000 years, in current times, the risk has grown". Salinity is one of the maximum brutal environmental stresses that abate crop productivity worldwide [2]. Initially, soil salinity is thought to represses plant increase in the shape of osmotic pressure that's then accompanied by the aid of using ion toxicity [3]. Rice (*Oryza sativa* L.) belongs to its own circle of relatives Poaceae. The simple chromosome quantity of rice is n=12. The species may beboth diploid or tetraploid. In this respect, (*Oryza sativa* L.) and *Oryza glaberrima* L are diploid species [2n= 24] . The Asian cultivated rice (*Oryza sativa* L) is the primary absolutely sequencedcrop genome and is a version crop species. Rice is taken into consideration as a prime meal crop throughout predominant nations worldwide. As a meals crop, it paperwork the staple meals of extra than 3 billion human beings accounting for approximately 50-80% of their everyday calorie intake. Salinity is a major obstacle to global grain crop production, especially rice and wheat. The identification and enhancement of salt-tolerant rice and wheat depending upon the genetic diversity and salt stress response could be a promising solution to deal with soil salinity and the increasing food demands. Plant responses to salt stress occur at the organismic, cellular, and molecular levels and the salt stress tolerance in those crop plants involves [5] regulation of ionic homeostasis, [6] maintenance of osmotic potential, [7] ROS scavenging and antioxidant enzymes activity, and [8,4] plant hormonal regulation. Numerous phytohormones (particularly ethylene) are thought of as coordinators between stress response and plant growth in the plant life cycle and play significant roles in plants and environmental interactions, such as salt stress, as ethylene synthesis and signaling are crucial. for plants' rapid adaptation to salt stress and resistance. extreme productivity of ethylene tends to inhibit the development and growth of plants, resulting in mortality.

A low level of Sodium performs as a micronutrient and a number of physiological functions that employ sodium, an important micronutrient but too much of it may cause salinity to the soil. Other examples of micronutrients include molybdenum, copper, zinc, iron, cobalt, and chromium. When NaCl builds up in the root, it is known to be toxic in the plant. Additionally, sucrose levels in store roots are increased by sodium chloride. High salt concentrations that are exposed to plant roots hinder plant growth and create wilted leaves. This is due to the fact that too much salt in the soil prevents plants from absorbing water and results in dry, discolored plant tissues. Plants may develop slowly but not exhibit any other evident symptoms when the salt level is high but not exceedingly high.

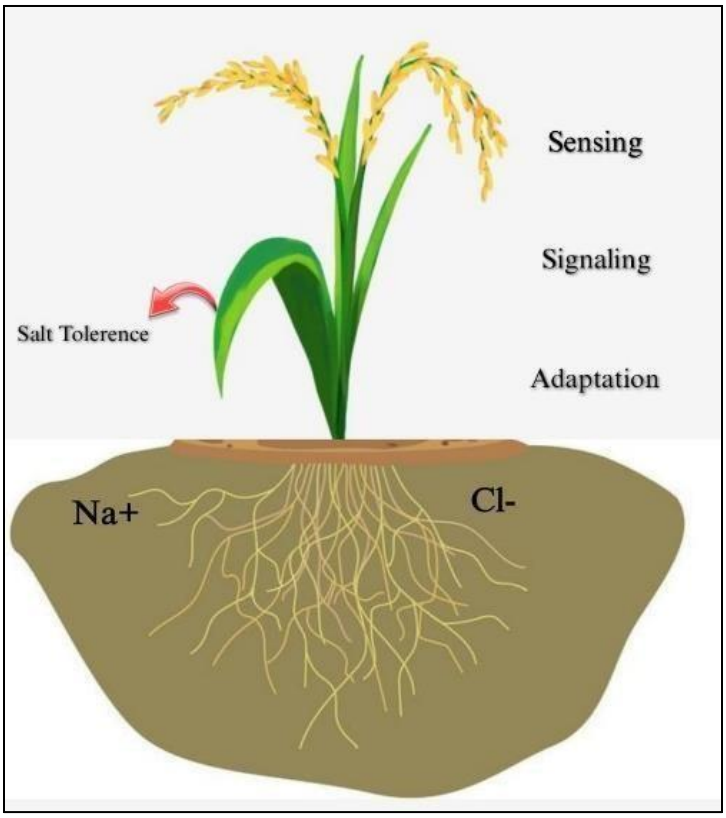

Fig.1 Salinity stress in rice plant

RESPONSE OF RICE UNDERGOING SALINITY

With the purpose of producing salt-tolerant rice cultivars, numerous morpho physiological research had been performed to date. The principal recognition of such a technique turned into maximizing thegenetic range among parental genotypes. Response of flora to salinity is a random and herbal technique [9,10]. Rice as a crop has been suggested as touchy withinside the seedling and reproductive stages and has ended in a discount in crop yield and productivity [11,5]. In the case of rice, salinity is observed to result in each biochemical and physiological modification inflicting boom inhibition and yield loss [12,13,14]. Several physiological parameters had been studied withinside the technique of assessment of authentic salt-tolerant strains to apprehend the drastic consequences of salt accumulation at the physiological level: plant height, plant dry weight, leaf damage, and Na^+-K^+ ratio [15,16,17]. Rice leaf mortality extended with extended salt strain in all rice cultivars at the early seedling stage. It is set zero to 300% leaf mortality in salt strain publicity after 7 days. Later in some months, salt strain suggests a discount of increase and development. It might alsoadditionally motivate the death of leaves and reduce leaf place and in the end, reduce the photosynthesis charge of the plan). The salt strain has precise results on plant molecular metabolism, specifically on leaf senescence. It also can injure the cells in transpiring leaves, and motivate rice plants to increase inhibition. The salt concentrated withinside the vintage leaves motivate the leaves, and death, which is critical for the survival of a plant [1].

MORPHOLOGICAL-PHYSIOLOGICAL REACTION

Resistance to salinity strain does now no longer depend on a single trait and thereby information of the tolerance mechanisms must appoint the examination of the reaction of rice beneath strain.An examination of the reaction of the underlying physiological mechanisms related to plant protection mechanisms being activated throughout the strain. The effect of salinity on plants is initiated via way of means of the osmotic effect characterized via way of means of reduced osmotic capacity accompanied via way of means of later ion inflicting ion toxicity. [18, 19] Salinity has been pronounced to lower leaf region quiet and additionally confirmed profoundmodifications in leaf anatomy in rice grown in-vitro [21] or in a greenhouse [22] as confirmedvia way of means of [23]. The ultra-structural observations briefed via way of means of [24]additionally ensured the inhibitory effect of salt on the leaf as a consequence hampering thephotosynthetic efficiency swelling of thylakoids accompanied via way of means of disruption ofchloroplastids. Salinity turned located to exert a severe negative effect on the mesophyll tissueeven stretching its harmful effect on the vascular bundles. Evaluation of the reaction of the cropplant at later levels turned into realizing the poisonous ionic effect of salt on plant life.

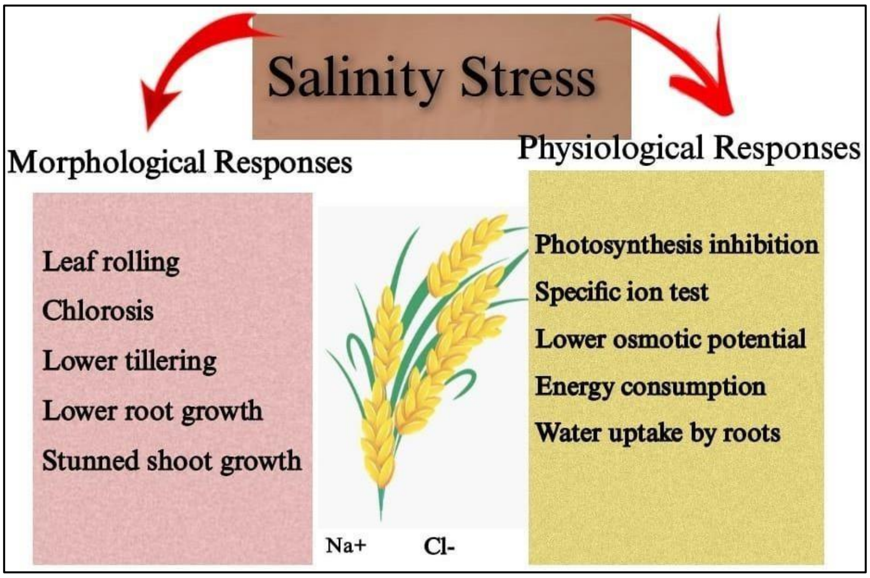

Fig. 2 Morphological, Physiological responses of rice due to high salinity stress

SALT PRESSURE TOLERANT GENE IN RICE:

Seed germination, seedling boom, and improvement, vegetative and flowering level boom, fruit set, and root device structural improvement are all harmed with the aid of using excessivesaline levels. Crop yields will subsequently go through because of this phenomenon [26]. Modern agricultural studies consist of using biotechnological technology and genetic engineering to observe crop tolerance mechanisms, explore tolerant genes, and cultivated sorts of tolerant vegetation through the use of molecular biology, molecular genetics, and different methods. The aim of plant tolerance studies is to expand tolerant cultivars; nevertheless, the mechanism of plant pressure tolerance is tough trouble to solve [27]. Modern agricultural studies consist of using biotechnological technology and genetic engineering to observe crop tolerance mechanisms, explore tolerant genes, and cultivated sorts of tolerant vegetation through the use of molecular biology, molecular genetics, and different methods. The aim of plant tolerance studies is to expand tolerant cultivars; nevertheless, the mechanism of plant pressure tolerance is tough trouble to solve [28]. Osmotic stress also causes nutrient absorption to be interrupted and stomata to close quickly, which reduces plants' ability to absorb CO2 and severely hinders photosynthesis [35]. Reactiveoxygen species (ROS) accumulate more during oxidative stress due to osmotic and ionic imbalance, which can seriously harm cellular macromolecules (such DNA, and structural elements (such as lipids and enzymes) [36, 37].

BIOENGINEERING TO INCREASE TOLERANCE TO SALINITY:

With the use of genetic transformation technology, scientists may transfer gene in a precise and controlled manner. Therefore, methods of genetic engineering would be advantageous to modify the biosynthesis pathways for osmoprotectants by accumulating such ROS-scavenging molecules. With the use of genetic transformation technology, scientists may transfer genes in aprecise and controlled manner. Therefore, methods of genetic engineering would be advantageous to modify the biosynthesis pathways for osmoprotectants by accumulating such ROS-scavenging molecules, lowering lipid peroxidation, and preserving the integrity of proteins and activities [41,43]. There are numerous efforts to change concentrating on genes of plants for enhancing salt tolerance and regulating ion transport including regulating the absorption of Na^+ and. The mechanism of compartmentalization is extremely significant. This mechanism's regulating genes have been found. An efficient way to produce antiporters is by engineering plants to overexpress the genes that code for them tolerant to salt plants.

DEFENSE DEVICE OF RICE IN OPPOSITION TO SALINITY PRESSURE:

Plant protection mechanisms to fight the poisonous effect of salt pressure may be classified into3 procedures *viz.*

- Tolerance to osmotic pressure thru osmotic adjustment,
- Na^+ exclusion from leaf blades by selective ion uptake and additionally law of uptake ofsodium ions at the molecular level,
- Tissue tolerance.

In order to manage up with the imminent photo-inhibitory effects, flowers go through the changeof their metabolic pathways including heat debauchery with the aid of using the xanthophyll pigments and electron switch to oxygen acceptors (now no longer water) that may bring about the formation of ROS (reactive oxygen species). The later reaction is but mitigated with the aid of using the initiation of the up law of numerous regulatory enzymes for including superoxide dismutase, ascorbate peroxidase, catalase, and numerous peroxidases [44,48]. The enzymatic antioxidant defense machine of flowers is which includes Superoxide dismutase (SODs), peroxidases, Catalases, and the enzymes of the ascorbate–glutathione cycle: Ascorbate peroxidase (APx), Monodehydro-ascorbate reductase (MDHAR), Dehydro-ascorbate reductase (DHAR), and Glutathione reductase (GR) at the same time as non-enzymatic antioxidants include: Ascorbate (AsA) and Glutathione (GSH) [49,50]. In rice, opinions are being set up as a long way as oxidative responses are concerned. Mishra et al. [120] said an growth in SOD hobby, APx hobby and GPX hobby, but reported an lower in CAT hobby with extended publicity to salinity levels. An anticipation of the above effects turnedinto but elucidated with the aid of using wherein an extended CAT hobby and reduced SOD andPOx hobby turned into discovered in salt tolerant lines.

CONSEQUENCES OF SALINITY STRESS IN RICE PLANT:

Rice is a crop with tremendous financial importance and is cultivated throughout 114 nations globally.However, the abiotic and biotic stresses can lessen its yield. This hassle may be worse in interest to the growth of the world populace and meal assets deficiency. Rice is at risk of salinity, specifically, in the early vegetative and later reproductive stages. Rice genotypes display extensive versions in salinity tolerance because of additive gene results. Studies indicated that rice is greater resistant at reproductive and grain filling than at germination and vegetative stages,in addition to low ranges of salinity can grow the resistance of rice to better and deadly salinity ranges. At present, salinity is the second form of pressure and is the maximum important hassle to rice manufacturing after drought. The results of salinity at the increase and yield of rice in thesubject had been nicely studied which include the look at genotypic variance for salt tolerance among the paddy germplasms [51]. Recent studies using – omics technology have discovered a hyperlink among modified DNA methylation styles and sundry gene expression throughout the genome in 3 rice cultivars with variable susceptibilities to growing salt and drought pressure [52].DNA methylation changes have been visible in each salt-tolerant and salt-prone rice sorts upon publicity into excessive salinity [4]. DNA immunoprecipitation with the 5-methylcytosine antibody and excessive throughput sequencing (MeDIP-seq) have been used to decide the genome-extensive methylation reputation of a salt- resistant rice range beneath elevated salinity in a current study [4].

CONCLUSION:

One of the primary abiotic variables that restrict crop growth, development, and yield is salinitystress. Rice is the primary meal crop go throughout several nations globally. With the acceleratedpopulace globally the call for rice is likewise growing in accordance. Rice, a glycophyte, with theaid of using nature is at risk of salinity and display extensive and bright reaction in opposition tothe damaging effects of accelerated salt accumulation. The plant protection machine in rice consists of arrests and remedies of the dangerous effects of salt toxicity at physiological, biochemical, and molecular levels [3]. Numerous studies using cellular, metabolic, and physiological analysis have revealed that, among different salinity reactions, mechanisms or tactics influencing ion transport are important.Hormone uptake, movement, and balance, osmotic control stress signaling, metabolism, and antioxidant metabolism play important roles in the adaptation of plants to salt stress utilizing the most recent developments in the industry metabolomic, transcriptomic, proteomic, and genomic data [4].

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