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Use of Biotechnology to Improve the Tolerance in Rice (*Oryza sativa*) to Drought Stress

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Abiotic stress factors are the main limitations to plant growth and yield in agriculture. Among them, drought stress, which is caused by water deficit, is probably the most impacting adverse condition and the most widely encounter Rice (Oryza Sativa L.) is one of the most important cereal crops that provides a staple diet for almost half of the world's population. However, rice yield and quality are affected by environmental stress. Drought is one of the most common environmental stresses affecting rice growth and productivity. There's the possible development of biotechnological tools to address the critical problems of crop improvement for a sustainable agriculture. Among the available biotechnological tools, the in-vitro culture alone or combined with mutagenesis, which are induced with physicochemical or biological agents by using (PEG) can be exploited to increase genetic variability and mutants, as a potential source of new commercial cultivars, in-vitro culture environments . Following this, it is preferred that there are more studies on finding the varieties of rice tolerant to drought stress by using biotechnological in order to reduce the risk of abiotic stress, which is the most important stresses of drought on agriculture and rice production.

Key words: Tolerance in rice, Drought stress, Biotechnological tools, Environmental stresses.

The second most commonly refined cereals, after wheat, in the world is Rice (Oryza sativa) and is a staple food for over half the world's inhabitants. Recently, note experts difficult environmental stresses, for instancewaterlogged soil, saline, frost, and high temperature, and drought decrease crop yields and damage quality, which guide to food insecurity. Under intense stress circumstances, crops totally fail, which in sequence may guide to high food prices, food shortage, migration of inhabitants from rural and villages insecurity.

One of the explanations to have a secure and sustainable food manufacture is to breed diversities that are tolerant to stress circumstances during their development and growth. Such inhabitants can be irradiated in vitro to bringgrown, multiplied and mutationsin the field for the choice of required genotypes. Applying a mixture of in vitro and mutation methods, new genotypes can be produced in a crop of rice; the instruction of mutations proposes the option to create only a

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restricted number of the required genetic alterations in varieties and genotypes , which are adjusted to the local eco-climatic situations. Local researcheshave demonstrated that alterations are able of a direct impact on the genetic material and its factors, particularly DNA (DNA) that is dependable for the constancy of the relocate of characteristics from one generation to another. Therefore, the "Coordinated Research Project on the In-Vitro Techniques for the Selection of Radiation Induced Mutations Adapted to Adverse Environmental Conditions" was commenced and centredmainly on the enhancement of vegetative proliferated plants.

Now a day's technology of plant tissue culture allocate the construction of large inhabitants of plants in a short period and on a year round foundation in the laboratory. Tissue culture and plant cell have been a practical tool to research stress tolerance instruments under in vitro situations. In vitro culture methods reduce environmental differences because ofdescribed controlled conditions, nutrient media, and homogeneity of stress function. Additionally, the simplicity of such managements facilitates studying large plant inhabitants and stress actions in a short period of time and restrictedspace.

Reproduction of drought stress by Polyethylene Glycol (PEG) brings drought stress on the plant sand important difference from the control carries on to enhance with the rising solute probable (Øs) . PEG-6000 has long been used as a consistentindicator under laboratory situations for checking the drought tolerant genotypes. This is for the reason that polyethylene glycol performs as a non-penetrating osmotic agent effecting into rising solute probable (Øs) and obstruction of a combination of water by the root system . Drought screening applying some seed technological parameters has been set up to be quite functional in a number of crops. Under laboratory situations. This method can be further expanded to test drought tolerance in other genotypes

Alterationmethods in mixture with the in-vitro culture have become a significantinstrument in improvement locally modified cultivars. Since the mid-twentieth century to this day, many studies were done to identify how to enhance the construction of rice. Under situations of drought stresses it is reviewed in the current study, the applying of some biotechnology in the improvement tolerance of rice to drought.

Rice (*Oryza sativa*)

The second main crop international fits in the genus Oryza and has two cultivated and 22 feralvariety. The cultivated variety are Oryzaglaberrima and Oryza sativa. Oryza sativa is produced all over the world. Several cultures have proof of early rice cultivation, containingIndia, China, and the evolutions of Southeast Asia. Conversely, the original archaeological proofappears from eastern and central China and times to 7000–5000 BC (Encyclopædia Britannica, 2010). Is sophisticated in more than 50 countries across Australia, Europe, Africa, South America, North America, and Asia, covering a whole land area of 164 million hectares with a construction level of about 723 million metric tons (FAO 2011). Rice is the basis of 27% of nutritional energy and 20% of nutritional protein in the expanding world (Redoña, 2004). Regarding 90% of the whole rice developed in the world is created by 200 million small cultivators (Tonini and Cabrera, 2011). Rice is fundamental to the lives of billions of people around the world, and producing rice is the mainparticularapplying of land for creating food, covering 9% of the earth's arable land. Calories from rice are mostly significant in Asia, particularly among the poor, where it reports for 50-80% of daily caloric eating (GrameneReference ID 8380, 2001). As a consequence ofincreasing in income andpopulation in main rice-consuming countries, the command for rice has been progressivelyrising over the years. Mohanty (2009) assessed that the worldwidecommand for rice will enhance from 465 million ton in 2012 to about 487 million ton in 2020. Consequently, a sustainable development in rice constructioninternational is required to make suremaintain human health, food security, and maintain the livelihoods of millions of small cultivators. One of the most severe long-term challenges to attain sustainable development in rice construction is weather change (Vaghefi *et al*., 2011; Wassmann and Dobermann, 2007; IFPRI, 2010). Rice sustainability and productivity are intimidated by abiotic and biotic stresses, and the outcomes of these stresses can be additionalheightened by remarkable changes in worldwide climate. One of the significant ways to make sure food safety and at the same time presentfeasible incomes for poor rice cultivators in the future is to expand new rice diversities that are more tolerant of the undesirable effects of a more unstable climate (Mackill *et al*., 2010;Haefele *et al*., 2010).

Abiotic stress

Dealing with plant environmental stress is the base of sustainable agriculture. Stress is aexperience that limits crop efficiency or devastates biomass. Stress can be biotic, reasoned by diseases and insects, or abiotic, which may containair pollution, salinity, flooding, mineral deficiency, metal toxicity, adverse temperature, adverse pH, and drought. Among the abiotic stresses having an effect on crop efficiency, drought is considered as most destructive (Borlaug and Dowswell, 2005).

Definition of drought

Droughts happen in all parts of the world countingareas that normallyobtain very high rainfall. Droughts reproduce water shortages over aarea for extensive periods of time such as a year, a season, or a month. Numerous variables such as humiditywinds, temperature, and geographic features, controlchangeability in the main water source i.e. precipitation over anarea [Mishra & Singh, 2010]. Drought can be described as the deficiency of irrigation or rainfall for a period of time enough to reduce soil moisture and damage plants. Drought stress effects when water loss from the plant surpasses the capability of the plant's roots to absorb water and when the plant's watercontent is decreased enough to obstruct with usual plant procedures. Naturally, water is generally the most restrictivefeature for plant growth.

Drought Stress on Rice

Drought is the most important environmental stress on agricultural constructioninternational (Cattivelli et al.2008) and aincredibleattempt is being concerned to progress crop yields in the face of rising water dearth. Drought has an effect onphotosynthetic activity, yield, pigment content, membrane integrity, osmotic adjustments, and water relations,plant growth(Benjamin and Nielsen 2006). Drought-prone areas and probable agricultural land with no irrigation system in place have been less developed than those with expanded irrigation systems or more consistent rainfall because ofproblems and high costs of expanding enhanced technologies. Consequently, rice yields are demonstrating a stablereducinginternationalinunirrigated and drought-prone regions. Drought is extensive in severalareas and are supposed to cause, by 2050, severe drought of more than 50% of all arable lands (Vinocur and Altman, 2005).The globe food grain constructionrequires to be doubled by the year 2050 to meet the food commands of the ever-risinginhabitants (Tilman *et al*., 2002), which is going to achieve 9 billion by that time (Virmani and Ilyas-Ahmed, 2007). Abiotic stresses show a main challenge in our mission for sustainable food construction, as these may decrease the potential yields by 70% in crop plants (Katiyar-Agarwal*et al*., 2006). Although, if the crop experiences an early drought, thusinfluencing germination, afterwards the suboptimal plant inhabitants is the main cause of low grain yield. Early season drought strictlydecreases germination and stand organizationmainlybecause ofdecreased water uptake during the imbibitions phase of germination, decreased energy deliver, and damaged enzyme performances (Okcu *et al*. 2005; Taiz and Zeiger2010). Development is anpermanentenhance in weight, size, or volume, which comprises the stages of cell elongation, cell division, and discrimination. Both cell enlargement and cell division are had an effect on under drought because ofdamaged enzyme activities, reduced energy supply and loss of turgor, (Kiani *et al*. 2007; Farooq *et al*. 2009; Taizand Zeiger 2010). Even though roots were less influenced than shoots (Liu *et al*. 2011). Drought as wellreduced leaf area because of loss of turgor and decreased leaf numbers (Farooq *et al*. 2010). All these issues supply to decreased dry matter accretion and grain yield under drought. The study of diversedevelopmental and growth occasions in crop plants with regard to time is named crop phenology. Drought powerfullyinfluences crop phenology by limitation the crop growth cycle with a few exemptions. While drought happens during the vegetative phase of crop development, it may significantlyreducefinancial yield. Drought stress during grain and reproductive filling stages is more disturbing (Reddy *et al*. 2003; Vijay 2004; Yadav *et al*. 2004; Lafitte *et al*. 2007).

World rice constructionapplies about 1,578km3 of water which is 30% of the fresh water appliedinternational (Trijatmiko, 2005). Rice, as a paddy field crop, is mainlyvulnerable to water stress and its most vulnerable to harm from water shortage, consistent with the available statistics, the proportion of drought influenced land region in the world more than doubled from the 1970s to the early 2000s, timing in relation to plant growth phase and concentration of the stress can all differsignificantly (Witcombe *et al*., 2008 and Wani *et al*., 2010). Of all the cereals, rice (Oryza sativa) is most vulnerable to harm from water shortage (Lafitte andBennet, 2003). Consistent withavailable statistics, the proportion of drought influenced land area in the world more than doubled from the 1970s to the early 2000s (Isendahl and Schmidt, 2006). Rice, as a paddy field crop, is mainlyvulnerable to water stress (Tao *et al*., 2006; Yang *et al*., 2008). It is assessed that 50% of world rice construction is influenced by drought (Bouman, *et al*. 2005). Water shortage is becoming progressively morecommon in irrigated regions because of falling water tables. Genetic development of rice for drought tolerance through predictable breeding is slow as a result of the low heritability of yield under stress, low inherent difference in the field and the restriction that there is typically only one experimentally droughted crop yearly (Ribaut *et al*., 1997). Drought can delaytransplanting, seeding, and/or crop organization, drought typicallycommunicate with the tillering phase which can origindecline in rooting and thetilling capabilities, leaf senescence, root functionor even death, and effectfinally in diminish of efficientyield and heads loss. Leaf gas exchange and leaf expansion are two such responsiveprocedures that can be reserved by drought stress. At the plant level, decreased leaf region is possibly the clear mechanism by which plants and crops limit their water loss in reaction to drought (Sadras and Milory, 1996).Rahman *et al*. (2002) stated that tiller number, plant height, panicle length, panicle number, 1000-grain weight, number of filled grains per panicle, total dry matter (TDM), harvest index (HI), and yield were reduced with stress. Grain yield was decreased noticeably in all cultivars with drought beginning at panicle beginning or at pinnacle. Water stress at pinnacledecreased grain yield more than other stress actions. The diminution in yield mainlyeffected from the decreased in productive panicle number and overflowing grain proportion. Kumar *et al.* (2006) set up that the proportion of untaken grain was considerably higher in sites that were influenced by drought at reproductive phase. Rahimi and Mostajeran, (2009) stated that one of the majordifficulties of rice productionand cultivation is the shortage of water sources, particularly during phases of low precipitation which have an effect on the vegetative development rate and the amount of yield.

Consequently, expanding drought-tolerant rice diversities and decreasing water expenditure during rice construction is critical to enhanced rice yield. Because of the multifaceted polygenic nature of drought tolerance, tries to develop this feature through predictablebreeding have met with little achievement. On the other hand, the classification and relocate of genes that presenttolerance / resistance to drought stress through transgenic machinery is frequentlyplaned as one resolution for defending crops beside a water stress environment and rising crop yields international, mainly in less expanded regions that are intimidated by food shortage and low crop efficiency (Nelson *et al*. 2007) .

Use some of biotechnology in rice tolerance to drought

Mutation

Mutation breeding is an instrument applied to revise the nature and function of gens which are the basis of plant growth and building blocks and improvement, thusgenerating raw materials for economic crops and genetic improvement (Adamu, and Aliyu, 2007). Mutation could be described as a relativelyand permanent rare modify in the number or series of nucleotides in a genome. Mutation happens naturally (unplanned mutation) or it can be unnaturallyencouraged by different mutagenic agents which is consequentlynamed inducible mutations (Singh, 1996). Mutation has been applied to createseveral cultivars with enhancedfinancial value and to reviseplant and genetic developmental events (Van *et al*., 1990; Bertagen-Sagnard *et al*., 1996). Diverse mutagenic agents are applied to induce favourable mutation at high occurrence that comprises chemical mutagens and ionizing radiation (Ahloowalia and Maluszynski 2001). Mutations are the instrumentapplied to revise the character and function of genes which are the basis of plants growth, the building blocks and development, thusgenerating raw materials for economic crops and genetic improvement (Adamu *et al*., 2004). Mutation origins different structural adjusts with DNA, such as a alteration in a single nucleotide foundation of a gene (point mutation), substitute of one nucleotide foundation by another, cutting of one or more foundationcouples in the DNA series (frame modify mutation), chromosomal reorganization, duplication, or lossof a chromosome sections (Poehlman andSleper, 1995). The initiation of mutation with compound mutagens relies on chemical mutagen attentiveness, period of action and other features (Alcantara *et al*., 1996). Induced mutation is achieved by the applying of chemical or physical mutagens. The rate of impulsive mutations is too low to be considered for useful purposes. Consequently, chemical or physical mutagens might be applied with in vitro or in vivo methods to enhance the mutation incidence (Lyakh and lagron, 2005). Mutation methods in mixture with tissue culture techniques presentainfluential technology to develop plants. It is probable to improvedeep-rooted plants by changing particularcharacteristics by inducing. Recent studies stated that plant introduction to diverse doses of gamma (5ØþÞ)-irradiationmay develop the tolerance to abiotic stress circumstances, for instance, drought and salt (Moussa, 2011 and Song at all 2012). Mutation method has been applied to generate many cultivars with enhancedfinancial value and study of plant and genetic developmental facts (Bertagen-Sagnard at all, 1996). Induced mutation has enormousserves and potentials as a flattering approach in genetic development ofcrops. A variety of mutagenic agents are applied to induce favourable mutation at high occurrence that comprises chemical mutagens and ionizing radiation (Ahloowalia, and Maluszynski, 2001). Gamma radiation, arranged of high energy photons, is a kind of ionizing radiation, capable to break through and cooperate with living tissues. It origins reduced growth rate and imitationabilityin company with DNA injure andmorphological alterations (Kovalchukat all, 2004 and Wiat all, 2007). Although, irradiation with low doses is identified to have stimulatory results on plant development, a perceptionconsigned to as hormesis (Calabrese, 2002). Information with reference to the applying of Gamma-ray as aninstrument to develop seed dynamism is still insufficient. The procedure of seed priming achieved with osmotic agents persuades the pregermi-native metabolism, mainly the antioxidant reaction and DNA mendpurposes, guiding to improved germination effectiveness, anattribute highly considered for agricultural functions(Ventura,et al. 2012) Priming actions might as wellprogress stress tolerance in developing seeds, leaving a type of “stress memory” .(Chen and Arora 2012). On the contrary with its highapplicability, modest information is accessible on physical priming techniques (Vasilevski, 2003).

In vitro Tissue Culture

Plant tissue culture methods are critical to severalkinds of academic examination, in addition toto many functionalfeatures of plant science. Presently, having become anestablished technology, the methods are not only applied for the studies in plant gene regulation and molecular biology but as wellfunctional to molecular breeding and plant biotechnology. The comparisons of the results persuaded by the stress in the plant cultured in-vivo and in-vitro situations propose that the in-vitro system can be applied as asubstitute to field valuations for revising the commonconsequence of water-stress on plant development and growth. The most extensivelyappliedtechnique for the choice of genotypes tolerant to abiotic stress is the in-vitro choice pressure method. This is derived from the in-vitro culture of plant cells organs or tissues on a medium complemented with choosy agents, allocatingregenerating and selecting plants with advantageousfeatures (Rosa and Aurelio, 2012). Callus, as acommenced material in plant tissue culture, is described as an unorganized tissue accumulationproducing on solid substrate by applying tissue culture skill, which can shape from numerouselements of large intact plants (Mineo 1990). During callus discrimination, only those highest and tangential cells in callus were motivated into energetically dividing cells, and the level of generalseparationgenerallyrelies on the hormone equilibrium of the support medium and the physiological situation of the tissue.dissimilarities in callus introduction among rice diversities were observed in some of the initial studies in rice tissue culture gained maximum callus arrangement in basmati rice cv.370 on MS medium complemented with 2.0mg/l of 2,4-D. Although, somatic embryogenesis was attainedby means of MS medium complemented with 2mg/l from each of 2,4-D and Kin. It has been stated that the subsequentfeatures outcome plant regeneration occurrence in genotype, rice; developmental phase of calli in the explants, carbohydrates source, hormonal composition of the medium, biaseddrought or water stress inducing managements and other medium complements (Saharan *et al*., 2004). Ilahi *et al*. (2005) stated that callus of a local diversity of rice (Oryza sativa L. cv. Swat-II) was provoked and the occurrence of callus introduction was studied on customized MS medium by means of a diversity of mixtures of 2,4-D and Kin, they as wellstated that addition of tryptophan to diverse mixtures ofcytokinins and auxins enhanced thecalli and embryogenic callus accumulationhave been productivelyreproduced on MS complemented with 1.0 mg/l of Kin and 0.5 mg/l of NAA.Khatun *et al* (2010) accounted that genotype dependence still plays a significant role for any plant tissue culture work and studied on callus regeneration and induction possible of twenty five rice cultivars through in vitro micro propagation and another culture find Pazuki.A and Sohani , M.M .(2013) that the most appropriate andresponsive rice cultivar in callus beginning is in reducing order: Gb > Hm >> Hn e" Gr. consequently can be used in tissue culture refereed breeding program .

Polyethylene glycol (PEG)

PEG is nontoxic, non-ionic and inertand of high molecular weight. It is very soluble in water, and is accessible at a extensive range of molecular weights (e.g., PEG-4000, PEG-4500, PEG-6000, and PEG-8000), it reproduces water shortfallsituations in cultured cells in a comparablemethod to that practical in the cells of intact plants subjected to genuine drought circumstances, high molecular weight PEG (PEG-6000) persuades water stress in plants by diminishing the water possible of the nutrient explanation without being taken up and with no proof of toxicity (Wani *et al*., 2010) . PEG is a polymercompound with severalfunctions from manufacturingindustrialized to remedy, it persuades morphological alterations of delighted plantlets, counting considerable statement of epicuticular wax and customized leaf outside structure, it is applied to change the osmotic probable of nutrient explanation and thereforepersuades plant water shortage in a comparativelymanaged method, it was supposed that PEG of large molecular weight does not infiltrate plant tissues and therefore is a perfect osmoticum for applying in hydroponics root medium (Michel and Kaufmann, 1973; Money, 1989). Al-Bahrany(2002) studied the reaction ofHassawi rice (Oryza sativa) callus to differing amounts of PEG persuaded water stress counting callus growth, water substance and proline accretion. In recent years, PEG has been extensivelyapplied to persuade water stress and drought tolerant cultivars have been recognized in several crops by expanding approachesderived from the applying PEG (Badiane *et al* 2004).

CONCLUSIONS

Therefore, we could feel the danger of abiotic stress and most importantly of the drought on the growth and production of strategic crops including the rice that needs to be high water requirements. The advantage of biotechnology can be explored, such as tissue culture and mutation induction, and the use of (PEG) in breeding and the development of rice varieties tolerant to drought stresses can grow and give production under the conditions of drought stresses.

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