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Potential of plant growth promoting bacteria (PGPB) on drought stress alleviation of wheat (*Triticum aestivum L.)* for dry condition- A Review

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Abstract

Lack of water is one of the limiting factors of wheat production in arid and semi-arid regions in the world and farmers suffer more in order to produce wheat. One of the strategy that requires wheat production or coping with drought is stress the use of probiotic and PGPR microorganisms. This bacterium with different mechanisms reduces the drought stress of wheat. PGPR by colonizing rhizospheres and endo-rhizospheres of wheat by increasing biofertilizer, lateral root production, extracellular polysaccharide production, phytohormone regulator, amino cyclopropane carboxylase deaminase, stimulants, induction and storage of osmolyte materials, antioxidants, regulation of genes that respond to stress and access to insoluble substances in resistance causes drought stress and systemic resistance in wheat. The end result is resistance to drought stress. In the present review, described the role of PGPR in increasing the resistance of wheat plant to drought stress.

Key words: Plant Growth Promoting Rizhobacteria, Wheat (*Triticum aestivum*), Drought Stress, Mitigation, Arid Situation

1. Introduction

Wheat is the staple food of the people in the world and it is necessary to increase its production to 50% by 2030 (Sardouie et al., 2019). Wheat and other crops are always exposed to stress from biotic and abiotic factors that reduce growth and yield (Pouri et al., 2019). These stress considered as physiological diseases in abiotic factors. Depending on the type of plant, abiotic stresses reduce plant yield by 50-82 %(Saharan et al, 2011). Abiotic environmental factors are the main limiting factor of agricultural products in the world (Kasim et al., 2012; Meena et al., 2017; Fahad et al., 2017). They are including heat, frost, salts, nutrient deficiencies and drought. In the current situation, intermittent droughts are the main reason for the decline of agricultural products, including wheat in the world (Pouri et al., 2019). Lack of water has a negative effect on the physiological activities (especially the ability of photosynthesis) of the plant and if the water shortage continues, the growth and production of the crop will be greatly reduced (Osakabe et al., 2014). And Reducing the global productivity of plants including wheat (Ullah et al., 2018). By use of PGPB can achieve the important goal of positive effects on plants and reducing the negatives effects of the chemicals and fertilizers to the environment (Di Benedetto et al., 2017). Potential of PGPR in reduction of drought stress in wheat can be used as potent biofertilizers (Gontia et al., 2016).

One of the important roles of plant probiotic bacteria is to increase plant tolerance to cope with environmental stresses (Zhuang et al., 2007; Yang et al., 2009). Drought mainly caused agricultural disaster, still the affects state of susceptibility of maize and wheat production combined with numerous co-varying factors (i.e., phonological phases, agro-climatic regions, soil texture) stayed unclear. (Daryanto & Wang., 2016). Drought caused on wheat lower yield reduction (20.6%) matched with maize (39.3%) which shown maize more sensitive to drought than wheat, particularly during reproductive stage but similar sensitive in the dryland and non-dryland regions. Wheat grown in the dryland was more prone to yield loss than in the non-dryland areas (Daryanto & Wang., 2016). Wheat is the most adaptable to changing climatic conditions and a balanced food quality (Mahpara et al., 2015). There was shown 80% probability that wheat production will dropped to long-term average faced to exceptional drought (Leng & Hall., 2019). The crop yield growth is required to meet the needs of future population growth. However, drought causes significant yield declines for rainfed and irrigated crops (Ray et al., 2018). Drought primarily limited the food production globally and is estimated to have reduced national cereal production by 9-10% and the production losses due to droughts were associated with a reduction in both harvested area and yields. (Lesk et al., 2016). Still needed to assess the effect of climate extremes on field crop production improving measures of adaptation for dry land and irrigated crops, as decreasing groundwater and valuable source of irrigation continuously during the drought period (Ray et al., 2018). The purpose of this study was to review the new findings and possibilities of biotechnology, properly PGPB toward decreasing the effects of drought on wheat production in arid areas.

2. Drought stress reduction mechanism by PGPR on crops under dry condition

Drought stress is one of the most important factors limiting crop productivity, especially in arid and semi-arid regions (Saleem et al., 2007). Bacterial compound has been effective role on physiological and morphological parameters of wheat plant and use as potential inoculant material in dry areas (Ilyas et al., 2020) (Table1.1). Drought tolerance effects on growth, dry matter and harvestable performance in most plant species. Inoculation with *Bacillus.Pumilus* increased the drought tolerance of *Glycrrhiza uralensis*. Caused preserve better leaf ultra-structure to retain the rational physical metabolism and improvement ability of the plant, for sure of high capacity of photosynthesis and chlorophyll content, finally improved the plant growth and water use efficiency. This endophyte biological inoculation strategy must be encourage expanded application of *G.uralensis* to cultivate, especially in arid and semi-arid regions (Zhang., 2019). PGPR in maize, rice, wheat, soybean and bean used in last decade for plant improvement. PGPR as free-living bacteria, colonize plant roots, exerting beneficial effects on plant growth using their own metabolism (solubilizing phosphates, producing hormones or fixing nitrogen) and directly affecting the plant metabolism (increasing the uptake of water and minerals), enhancing root development, increasing the enzymatic activity of the plant or “helping” other beneficial microorganisms to enhance their action on the plants, or may promote the plant growth by suppressing plant pathogens (Montaño, F Perez., 2014). Soil microbiome, specially PGPR are halotolerant having various and lots of mechanisms that can enrich the plant nutrients availability by them or improve the growth. Including phytohormone production, Phosphate Solubilization, Siderophore production, from them use of ACC as only source of Carbon Nitrogen, reasoning its general effect on plant growth have to considered to moderate the level of ethylene (Shilev., 2020). By bacteria with high osmotical tolerance in the area around the root, it may act synergistically with synergism with glycine betaine produced by the plant in response to stress, and increase drought tolerance in the plant**.** PGPR improve growth with different mechanisms and the plant's resistance to various biotic and abiotic environmental stresses (Ahmadzadeh., 2013). Probiotic bacteria live in symbiosis with plant roots (Hill et al., 2014: Ahmadzadeh., 2013). The term probiotic was first used to fluorescent species of the genus *Psedomonas* by Hass and Defago(Hass & Defago., 2005). The term probiotic microorganism in sustainable agriculture was introduced at the Second International Conference on Organic Agriculture Research in 2008 year (Picard et al., 2008). Demographic composition of microbial organisms in the plant root system creates interaction with plants that produce plant growth metabolite (Schmidt et al., 2014). Rhizobium do not form nodules in many plants, but are good root colonizers and nitrogen fixation. rhizobium’s can produce phytohormones, Siderophore, hydrogen cyanides, and are soluble in organic and inorganic phosphates, they also colonized the roots of many non-legume plants (Antoum et al., 1998). In this bacterium, major outer membrane protein (MOMP) shows stronger adhesion to cereal crops roots than legumes and tomatoes (Ahmadzadeh., 2013).

Numerous studies show that Rhizobacteria with various mechanisms such as synthesis of Aminocyclopropane carboxylate(ACC) deaminase, production or alteration of plant hormonal balance, increase in antioxidants, improve soil structure through the formation of aggregates by extracellular polysaccharide (EPS) bacteria play an important role in Reduces the effects of drought stress or increases plant resistance to drought stress. The EPS compound has unique properties such as water retention and adhesion (Grover et al., 2011).

3. PGPR regulated Phytohormone, deaminase, Exopolysaccharide (EPS), antioxidant, Osmolytes, volatiles and Genetically factors on drought tolerance of plants

There are several strategies for compatibility and reduction of plants against drought stress, like PGPR has a significant role in reducing drought stress in plants. Biofertilizer is a process by which microbes increase the plant's greater and better access to nutrients such as phosphorus and trace elements (Lugtenberg & Dekkers., 2001). Causes of increased plant growth due to these factors include nitrogen fixation and uptake, phosphate dissolution, increased access to heavy metals, sulfur oxidation and methane oxidation (Vessey., 2003). An important role of Rhizobacteria is the growth stimulant of plants due to their ability to nitrogen fixation (Vessey., 2003). Bacteria play an important role in the formation and strength of aggregates by producing extracellular polysaccharides, biofilms, balance, regulate the flow of water and nutrients in plant roots (Grover et al., 2011). Use of bacteria lineages producing EPS in products is an adoptable strategy with environment that improves drought effects on plants. The bacteria strains by different mechanisms like as osmolytes production, phytohormon production, antioxidant synthase used to create drought tolerant in plants (Ilyas et al.,2020). Lack of water in the plant leads to a decrease in the turgens of plant cells, closing the pores and thus stopping photosynthesis and increasing light respiration. On the other hand, the amount of ethylene hormone also increases (Saleem et al., 2007).

3.1. ACC deaminase

Acc deaminase activity in some bacteria (choromobacter piechaoudi) is effective in tolerating water stress and causes the plant to gain wet and dry weight (weber et al., 2009). Growth response of winter wheat with inoculation of ACC+ Bacteria depended on the genotypes and these variations might be led to new selection strategy for drought tolerance in shortage water situation (Salem et al., 2018). Two years multi locations experiments on wheat showed optimum yield with low water in semi dry climate by ACC-deaminase enzyme and this enzyme may reduce level of harmful ethylene to diminishe drought stress and uptake of soil moisture from the lower parts through increasing roots (Shakir et al., 2012).

3.2. Exopolysaccharide (EPS)

Bacterial EPS plays an important role in increasing plant resistance to drought stress (Grover et al., 2011). The wheat treated PGPR + Salicylic acid (SA) increased highly leave protein and sugar and keeping greatly chlorophyll contain, chlorophyll fluorescence, performance index under rainfed farming of wheat. The integrated use of PGPR and SA the plan of eco-friendly for reducing moisture stress in plants seems to be assured (Khan & Asghari., 2019). Aggregates produced by EPS bacteria reduces meaningfully the impact of drought stress and regulates the flow of water and nutrients in the plants roots (Grover et al., 2011). EPS can combine with Na^+ cations to take it out of direct reach of plant roots by forming a pod of soil around the root, it reduces the rate of entry of Na^+ ions in the apoplast pathway (Dimpka et al., 2009). The use of EPS-producing bacterial strains in crops is an environmentally friendly strategy that improves the effects of drought stress on plants. These strains use various mechanisms such as osmolyte production, phytohormone production and synthesis of antioxidants that create drought tolerance in plants (Ilyas et al., 2020).

3.3 Antioxidant

Abiotic stresses lead to numerous physiological disorders in plant growth and development such as metabolic toxicity, membrane degradation, production of reactive oxygen species (ROS), inhibition of photosynthesis, reduced absorption of some nutrients and changes in hormone levels and ultimately reduce plant growth and yield (Shanker & Venkateswarlu., 2011). Wheat plant activate antioxidant defense mechanisms of Abiotic stresses, which help maintain the structural integrity of cell components and perhaps reduces oxidative damage. and, H_2O_2 signaling can help the wheat crop withstand environmental stresses. ROS is just one of the potential parameters of plant biological tolerance to environmental changes (Caverzan et al., 2016). ROS is involved as signaling molecules in processes such as growth, cell cycle, evolution, aging, programmed cell death, stomatal conduction, hormonal signaling, and regulation of gene expression. (Inze et al., 2012). The presence of reactive ROS, reactive nitrogen species (RNS) is essential for full adaptation to drought, with the activation of the antioxidant system, other marker stresses often increase during progressive dehydration, with various traits helping to tolerate drought. And includes water loss reduction, osmotic potential accumulation, compatible solute synthesis, excessive energy loss, activation of defense systems and antioxidant repair, production of sclerenchyma tissue, enhancement of cell wall and cell interaction and other growth regulatory mechanisms such as smaller leaf differentiation. Recovery from dehydration is often influenced by light intensity with negative interference, is lower recovery in more light. The activation of the antioxidant system following drought is one of the important goals. Excessive expression of some enzymes can lead to a beneficial increase in drought tolerance (Laxa et al., 2019). Drought causes overproduction of ROS and leads to oxidative stress. Drought-induced ROS directly damages various macromolecules, including proteins and nucleic acids, which eventually lead to plant cell death. Antioxidant boosts the immune system is thought to be an acceptable approach to wheat drought tolerance. In fact, ROS affects plants in two ways; first, function as toxic byproducts of stress metabolism and secondly, important signal transduction molecules (Miller et al., 2010). On the other hand, various metabolites are biosynthesized in plant cells under drought stress, such as: nominal protectors, phytohormones, antioxidant signaling agents to minimize the damaging effects of drought in plants. Several plant genes were rearranged during drought stress, and overexpression of some plant genes has improved plant drought tolerance (Hasanuzzaman et al., 2018). Beneficial bacteria are a promising way to control drought stress in wheat (Kasim et al., 2013). Enzymatic components include superoxide dismutase (SOD), catalase (CAT), ascorbate peroxidase (APX), and glutathione reductase (GR). Non-enzymatic components include cysteine, glutathione and ascorbic acid (Gill etal., 2010). Catalase (CAT) genes response differently to diverse stress conditions (Scandalios., 2005). In wheat, a mutant line impairs photosynthesis by reducing APX thylakoid activity (Danna et al., 2003).

3.4. Osmolytes

Plants adaptation to drought stress is associated with metabolic adjustments that lead to the accumulation of several compatible solute/ osmolytes like proline, sugars, polyamines, betaines, quarter- nary ammonium compound, polyhyric alcohols and other amino acids and water stress proteins like dehorns (Yancey et al., 1982). PGPR secretes osmolytes in response to drought stress, which act synergistically with plant- produced osmolytes and stimulate plant growth (Paul et al., 2008). Trehalose is a glucose-lowering disaccharide that is produced in bacteria under stress conditions such as heat, drying, oxidative stress, etc. Terhalose may act as a signaling or regulatory molecule in some cells and stimulate the metabolism of Trehalose transferred to Glucose and glycolysis bond. (Elbein et al., 2003). As the composition of ectoine (Pastor et al., 2010; Nunes, 2012). Another main factor in boosting plant growth and increasing tolerance to osmotic conditions is the ability of bacteria to produce (Indole-3-acetic acid) IAA hormone and ACC deaminase activity in *Chromobacter piechaudi* is effective in helping to withstand water stress in peppers and tomatoes, resulting in significant weight gain. Ethylene produced in the inoculated plant is reduced compared to the inoculated plant (Weber et al., 2009). Ectoine ($C_6H_{10}N_2O_2$) is a natural substance in bacteria that, as an osmolyte, plays a key role in withstanding environmental test stresses (Galinski et al., 1998). The action is amphiphilic and increases the water content by reacting with hydrophobic proteins under severe mousse conditions (Cayley et al., 1992). Glycine Betaine is found in many plants and has an osmotic protection effect (Osmoprotectum), in addition to osmotic protection, *Bacillus subtilis* is an effective protector against frostbite (Hoffman & bremer., 2011). This compound is used to increase the plant's tolerance to many salinity stresses, drought, cold and high temperatures (Ahmadzadeh., 2013).

3.5. Volatiles

Volatiles are promosing candidates for repid non- invastive technique to assess crop drought stress and its mitigation during stress development (Timmuk et al., 2014). The evaluating stress by produced volatiles can deliver an effective platform for quick screening of potent bacteria and that priming with rhizosphere bacteria isolated from harsh environments as an innovative way to plant water use efficiency enhancements. The current advancement greatly will contribute the food security problems related to climate change (Timmusk et al., 2014). Ordering on plant signaling of plant hormone by PGPR is promising method for increasing performance of the plants (Shilev., 2020). The wheat plants co-inoculated with *Azotobacterchrocoocum* and *Pseudomonas sp*. alleviated drought stress through increased anatomical alterations like as epidermis thickness, ground, mesophyll and phloem tissues, diameter of xylem vessel and dimensions of vascular bundles of the root system, while water shortage levels (75, 50 and 25% field capacity) decreased the anatomical values of the un-inoculated wheat cultivars (El-Afry et al., 2012). The potential of using the host as a selective indicator to engineer microbiomes mediated changes in the rhizosphere surroundings improved adaptation of the wheat to drought stress (Jochum et al., 2019). The drought tolerant Rhizobacteria inoculation in wheat can be avoid production losses in drought prone regions (Raheem et al., 2017).

3.6. Phytohormone

Auxin, gibberellin, cytokinin and abzazic acid are the main groups of growth regulators or growth stimulants in plants (Arshad & Frankenberger., 1993). Cytokinin also regulate cell division in shoots and roots (werner et al., 2001). Gabrieline is involved in elongation internodes and stimulates the growth of many grass families, especially in wheat GA1 and GA3 it causes elongation inter nodes, GA3 plays an important role in increasing the elongation of aerial part of shoot and roots (fu & Harberd., 2003). Auxins are the most abundant plant hormone produced by species of *Azospirillum*. These bacteria directly increase the branching and root length and expansion of capillary roots by producing the hormone Indole-3- acetic acid, also, the production of some growth-promoting volatiles such as acetone and 2R, 3R- Butanediol is effective in stimulating and increasing the plant (Hass & Defago., 2005). (Acetone) and 2R, 3R-Butanediol are produced from Acetaldehyde or Acetolactate substance in *Bacillus subtilis* from two different pathways, eventually converted to 2R,3R Butanediol by Acetone reductase enzyme (figure1). (Xiao & Xu., 2007). PGPR, regulates ethylene production in the plant root in synthetic pathways, ethylene is converted to the Ammonia and α- Ketobutyrate by the enzyme ACC deaminase, the ACC Aminocyclopropane (Fig1) (Glick et al., 1998). Decreasing ethylene increases root longitudinal growth. In the second pathway, bacteria use amino acids to production of indole acetic acid and increase of cytokinin derivatives. and these two hormones, increase the conversion S- adenosyl methionine (SAM) to the ACC combination (Madhaiyan et al., 2006). ACC as a source of nitrogen that is used by bacteria, on the other hand IAA also increases the production of lateral roots, the ethylene production increases rooting and sub-root production and prevents longitudinal root growth and nodule formation (figure 1).

4. Genetic altering mitigation of drought stress by PGPR

Several genes responsible for the production of test-regulating enzymes are expressed in drought stress or salinity and cold (Buchanan et al.,2000). The wheat inoculated with bacteria that lost the gene SFP-type PPtase enhanced the plants survival multiple and increased biomass three times higher compared with wild types (Timmusk et al., 2015). However, the virus- induced silencing gene for drought stress control in wheat plant reported (Manmathan., 2013). The Inoculation of PGPR caused the better root growth, better plant height, improving moisture and feeding nutrients results on growth and yield improvement in wheat (Shakir et al., 2012). Drought stress is caused by the limit availability of water in the soil which ultimately reduces turgor, nutrient absorption, growth, and yield of plants. Stomatal closure results in decreased photosynthetic rates in plants. Plants adjust the vital processes to combat drought stress.

However, the plant responses are controlled by their genet makeup and the duration of the drought stress (Ullah et al., 2018). The observed deferential phosphorylation pattern DAN-5 in susceptible and resisted wheat varieties can be as molecular selection base of tolerance and sensitive to drought stress and salts on wheat (Brini et al., 2007). Some bacteria, like most species of *Azospirillum*, are believed to cause root morphological changes and greatly increase plant drought tolerance. Study on the sixth type of secretory system in Vibrio anguillarum shows that some of the proteins of this secretory system such as (vtsA-H) are involved in the expression of regulatory genes in response to environmental stresses (Weber et al., 2009).

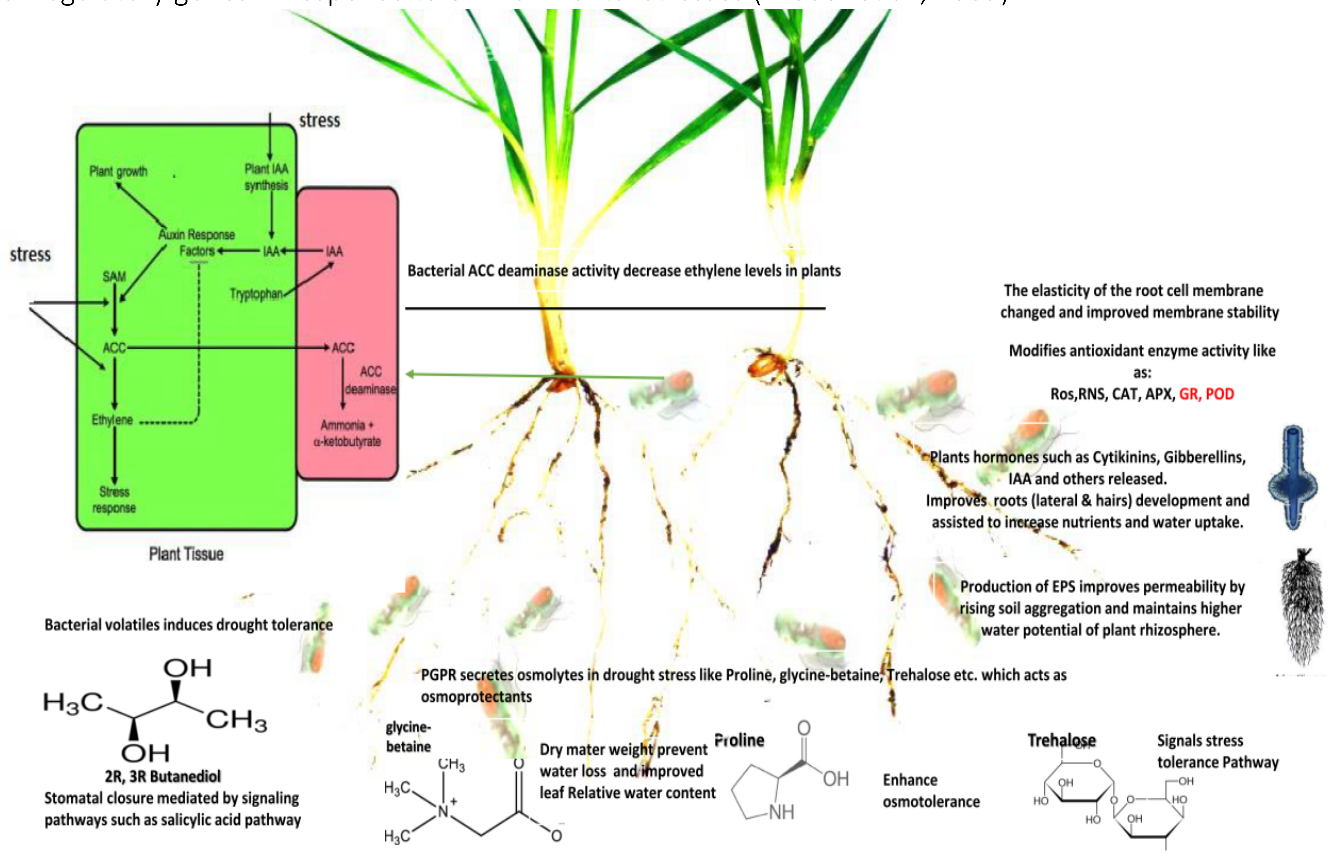

Fig. 1. Mechanism of plant drought tolerance induced by PGPR.

5. PGPR types drought tolerant of wheat crop

A research demonstrated that EPS, osmolyte, stress hormones, antioxidant enzyme-producing bacterial strains impart drought tolerance in wheat and improve its growth, morphological attributes, physiological parameters, osmolytes production, and increase antioxidant enzymes (Ullah et al., 2018). Most species of *Azospirillum* genus, especially *A. brasilense* and *A. lipofernum*, play an effective role in providing nitrogen to wheat, sorghum and corn. Their main role is to expand the roots to increase food absorption. In *A. brasilense*, membrane protein (MOMP) is involved in identification and binding (Ahmadzadeh., 2013). The bacteria (strain LTYR-11ZT) isolated from the leave of (*Alhagi sparsifolia* Shap) as represents of one top drought tolerant plant, efficiently colonized the rhizoplane of *Arabidopsis* and wheat and promoted the growth of wheat and enhanced its resistance to drought stress. This Strain engaged to increase accumulation of soluble sugars, decrease proline, malondialdehyde (MDA), and reduction decay of chlorophyll in leaves drought-stressed of wheat. It will be support the development of a novel biotechnology to improve drought tolerance of crops in dry ecosystem (Chen et al., 2017). Another research showed the *Bacillus venlezensis* bacteria (strain 5113) helps to produced metabolites in wheat which increase the tolerance against drought, frost and heat and is effective on regulating factors of growth enrich and environmental stress on wheat plant (Abd El-Daim et al., 2019). Some bacteria induce complete tolerance to osmotic pressure. Some PGPR strains (*P. polymyxa*, *A. calcoaceticus*, *P. putida* and *P. fluorescens*) Improvement acacia tolerance to drought (Getahun et al., 2020). Two strains of bacteria, *Bacillus amyloliquefaciens* 5113 and *Azospirillum brasilense* No40 were used on seedling of wheat, showed different mechanisms created on plant's tolerance to drought stress and high strength PGPR causes wheat tolerance in dry conditions (Kasim et al., 2013). The wheat seedling inoculated with *B. subtilis* strain had higher yield and higher tolerability than untreated isolates (Barnawal et al., 2017). The two Bacteria strains (HSP17, Hpx1, SAWS) in wheat leaves increased the enzymes activity involved in Ascorbate glutathione redox and improved homeostatic mechanisms through priming and reduced serval stress for controlling drought in wheat (Kasim, 2018). The existence of phenasine-producing bacteria in wheat seedling rhizosphere longer adjustment resulted to tolerance and preventing higher drought stress (Mahmoudi et al., 2019). A reseach that shows exopolysaccharide-producing drought tolerant bacteria. The bacteria identified as Bacillus sp, Bacillus licheniformis, Bacillus megaterium and Bacillus pumilus (Susilowati et al., 2018). Here we show that the Sfp-type PPTase gene in *P.polymyxa* is a gate-keeper for the bacterial drought tolerance enhancement (Timmusk et al., 2014).

Table 1.1: List of studies on PGPR for drought tolerance in wheat.

N	Identification	Activities	Effecting and result	References
1	*Azospirillum lipoferum* AZ1, *A. lipoferum* AZ9, *A. lipoferum* AZ45	PGPR increases relative water content and lessens leaf water potential	diminish drought stress, rises drought tolerance, enhance plant growth and yield under drought conditions	Arzaesh et al. (2011)
2	*Bacillus amyloliquefaciens 5113 Azospirillum brasilense N040*	The antioxidant enzyme activity declines, growth-promoting bacteria decrease the amount of oxygen faced stress to dryness . Priming caused in lesser activities of ascorbate peroxidase (APX) and shortened transcript levels of the stress-related genes (ascorbate peroxidase (APX1), S-adenosyl-methionine synthetase (SAMS1), and the heat shock protein (HSP17.8)	It strengthens the growth of wheat and promotes its survival, increases the fresh and dry weight of wheat, the PGPR may increase drought resistance over several mechanisms.	Kasim et al., (2013)
3	*Bacillus. thuringiensis* AZP2 *Paenibacillus polymyxa* B	Rises the production of antioxidants, the substances that respond most to drought are: Three key volatiles were recognized as the most responsive	Promotes higher survival of drought-stressed plants, and in greater photosynthesis and	Timmusk et al., (2014)

		to drought stress: benzaldehyde, beta-pinene and geranyl acetone.	biomass production. two to three times longer root hairs, and longer and denser lateral roots.	
4	*Burkholderia phytofirmans* strain PsJn	ACCdeaminase activity, and sidrophore production	Decreased oxidative stress and increased mineral components of wheat.	Naveed et al., (2014)
5	*Ochrobactrum anthropic* DPC9+ *Pseudomonas* spp. DPB13+ *Pseudomonas spp*.DPB16 (consortium).	Synthesis of Siderophore, ACC deaminase activity, indole-3-acetic acid production, and phosphate solubilization.	Enhanced plant growth, and foliar nutrient concentrations, and significantly improved antioxidant properties of the plants.	Chandra et al., (2019)
6	*Bacillus sp, Bacillus licheniformis*, *Bacillus pumilus* and *Bacillus megaterium*	exopolysaccharide-producing	drought tolerant bacteria	Susilowati et al., (2018)

Conclusion

Wheat is major human food source; drought stress is one of the severe environmental constraints for the production of this crop. PGPR helps solve future food security problems by increasing wheat resistance to drought stress by creating resistance and adaptation. Plant interaction and PGPR in drought conditions change soil properties and affect wheat plant. PGPR acts as a biofertilizer and enables the absorption of elements in the best possible way. Mechanisms obtained by PGPR such as osmotic response and induction of new genes, regulation of growth hormones have a vital role in ensuring the survival of wheat plants in drought stress conditions have beneficial effects on wheat growth and yield. The development of drought tolerant crops through genetic engineering and plant breeding is a long and necessary process. The use of microorganisms in agriculture opens a new way to use dry lands, reducing the effects of drought and creating resistance to drought stress is a strategy to reduce the costs of useful agricultural technologies. it found from the articles that the use of these microorganisms in arid and semi-arid regions through various mechanisms of action, has beneficial effects on the growth and yield of wheat production. Strengthening this strategy and using these microorganisms in the future will solve some of the human problems in wheat production.

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