**Effect Of PGPR ON Seed germination under salt condition./ Effect of carrier based Bio-formulation on plant growth under salinity stress condition.**

**INTRODUCTION**

Pea (Pisum sativum L.) is a leguminous, annual herbaceous plant with a one-year life cycle. Pea is considered a cool season crop with planting taking place from winter to early summer depending on the location. Seeds may be planted when the soil temperature reaches 10ºC, with plants ideally growing at temperatures of 13-18ºC. Peas do not thrive in summer heat or lowland tropical climates, but they do grow well in cooler high altitude tropical areas. Multi-storied agroforestry system offers production of various vegetables under different shade conditions by maximum utilization of natural resources. The average pea yield in agroforestry systems was 30 to 50% higher, especially in hot climate region.[7] **ELABORATE MORE??**

**Introduction does not carry any Headings.?**

**Focus on then Heading and elaborate brief to contribute around 5-10 pages of Introduction:-**

* **Discuss about then Agriculture problem?**
* **Discuss salinity and their problem in terms of India. With statistical data and refences**
* **Explain how to overcome this using Bioformulation. Explain Bioformulation+Why are you use Bioformulation (BF)?**
* **Role of BF & their effect on plant growth with examples.**

**REVIEW OF LITERATURE PART:-**

EXPLAIN ALL THE INTRODUCTION POINTS WITH HEADING AND WITH DETAILED REVIEW. **FOCUSON THESE KEYWORDS:-**

* EXPLAIN STRESS AND THEIR TYPES:-
* FOCUS ON SALINITY STRESS
* FOCUS ON MODE OF ACTION
* BIOFORMULATION THEIR TYPES? EXPLAIN EACH OF THEM
* ALSO EXPLAIN SOLID BASED FORMULATION?
* PGPR THEIR TYPES+ MODE OF ACTION EXPLAIN MAJORLY THE DIRECT AND INDIRECT MEANS
* FOCUS ON ACC DEMINASE MECHANISM. HOW ACC DEAMINASE POSITIVE ISOLATES OVERCOME THE SALINITY STRESS.

**REVIEW PART:-**

**SEED GERMINATION/ EFFECT OF BIOFORMULATION ON SEED GERMINATION:-**

ADD THE TEXT AS PER THE HEADING BY IMPLEMNTING THE PGPR BF EFFECT:-

Seed germination is a parameter of the prime significance, and fundamental to total biomass and yield production and consists of a complex phenomenon of many physiological and biochemical changes leading to the activation of embryO . A significant negative correlation generally exists between the seed germination percentage, time for seed germination and level of salinity. During seed germination, salinity results in many disorders and metabolic changes such as solute leakage, K+ efflux and -amylase activity. Firstly, salinity reduces moisture availability by inducing osmotic stress and, secondly, creates nutrient imbalance and ionic toxicity. Cell membranes are the hotspots for controlling active and passive transfer of solutes, and regulating plant nutrient uptake. An imbalance of mineral nutrients under salinity stress generally alters the structural and chemical composition of the lipid bilayer membrane, and, hence, controls the ability of the membrane for selective transport of solutes and ions inwards and, the membrane could become leaky to the solutes they contain.[1]/References should not be in that format it is like (Afzal .M and Shahnaaz. K.2020)-if 2 people are there if more then it is like (Afzal.M et.al., 2020)

Germination is a critical stage in the life cycle of weeds and crop plants and often controls population dynamics, with major practical implications. Seed germination is the critical stage for species survival . In recent 20 years, desertification has been recognized as a major environmental problem and is a major focus of United Nations Environment Programme . Vegetation is a protector of the soil against water and wind erosion as well as a casualty of soil erosion [2]

Germination is the first and sensitive stage of the plant life cycle. This stage of growth is strictly influenced by environmental factors especially, temperature and humidity .Salinity is a world–wide problem and it is particularly serious in arid and semi-arid regions. Salinity can affect germination and growth either by creating an osmotic pressure that prevents water uptake or by toxic effects of sodium and chloride ions . High salt concentration in the soil or in the irrigation water can have a devastating effect on plant metabolism, disrupting cellular homeostasis and uncoupling major physiological and biochemical processes[3]

Germination is a critical part of plant life histories. The ability of their seeds to germinate at high salt concentration in the soil is therefore of crucial importance for the survival and perpetuation of these species. In saline habitats, seed germination takes place after high precipitation, i.e., under conditions of reduced soil salinity . The ability of the soil seed bank to remain quiescent at a high salt level and to germinate immediately after salinity reduction is very significant not only to halophytes, but also to other species in colonizing their environment. Although salinity stress mostly reduces the germination percentage and delays the onset of germination, its effects are modified by interactions with other environmental factors as temperature and light. Salinity can affect germination by affecting the osmotic component, which the ionic component[4]

**PLANT GROWTH PROMOTING RHIZOBACTERIA**

Plant growth promoting rhizobacteria (PGPR) shows an important role in the sustainable agriculture industry. The increasing demand for crop production with a significant reduction of synthetic chemical fertilizers and pesticides use is a big challenge nowadays. The use of PGPR has been proven to be an environmentally sound way of increasing crop yields by facilitating plant growth through either a direct or indirect mechanism. The mechanisms of PGPR include regulating hormonal and nutritional balance, inducing resistance against plant pathogens, and solubilizing nutrients for easy uptake by plants. In addition, PGPR show synergistic and antagonistic interactions with microorganisms within the rhizosphere and beyond in bulk soil, which indirectly boosts plant growth rate. There are many bacteria species that act as PGPR, described in the literature as successful for improving plant growth. However, there is a gap between the mode of action (mechanism) of the PGPR for plant growth and the role of the PGPR as biofertilizer—thus the importance of nano-encapsulation technology in improving the efficacy of PGPR. Hence, this review bridges the gap mentioned and summarizes the mechanism of PGPR as a biofertilizer for agricultural sustainability.[5]

Plant growth promoting rhizobacteria (PGPR) is a group of bacteria that can be found in the rhizosphere]. The term “plant growth promoting bacteria” refers to bacteria that colonize the roots of plants (rhizosphere) that enhance plant growth. Rhizosphere is the soil environment where the plant root is available and is a zone of maximum microbial activity resulting in a confined nutrient pool in which essential macro- and micronutrients are extracted. The microbial population present in the rhizosphere is relatively different from that of its surroundings due to the presence of root exudates that function as a source of nutrients for microbial growth . Weller and Thomashow prove that the narrow rhizosphere zone is rich in nutrients for microbes compared to the bulk soil; this is shown by the quantity of bacteria that are present surrounding the roots of the plants, generally 10 to 100 times higher than in the bulk soil. The microbial colonizing rhizosphere includes bacteria, fungi, acticomycetes, protozoa, and algae. However, bacteria are the most abundant microbial present in the rhizosphere . The enhancement of plant growth by the application of these microbial populations is well known and proven . The term “plant growth promoting rhizobacteria (PGPR)” for these beneficial microbes was introduced by Kloepper and Schroth [, paving the way for greater discoveries on PGPR. PGPR are not only associated with the root to exert beneficial effects on plant development but also have positive effects on controlling phytopathogenic microorganisms . Therefore, PGPR serve as one of the active ingredients in biofertilizer formulation. Based on the interactions with plants, PGPR can be separated into symbiotic bacteria, whereby they live inside plants and exchange metabolites with them directly, and free-living rhizobacteria, which live outside plant cells . The working mechanisms of PGPR can also be separated into direct and indirect ones. The direct mechanisms are biofertilization, stimulation of root growth, rhizoremediation, and plant stress control. On the other hand, the mechanism of biological control by which rhizobacteria are involved as plant growth promotion indirectly is by reducing the impact of diseases, which include antibiosis, induction of systemic resistance, and competition for nutrients and niches]. Symbiotic bacteria mostly reside in the intercellular spaces of the host plant, but there are certain bacteria that are able to form mutualistic interactions with their hosts and penetrate plant cells. In addition to that, a few are capable of integrating their physiology with the plant, causing the formation of specialized structures. Rhizobia, the famous mutualistic symbiotic bacteria, could establish symbiotic associations with leguminous crop plants, fixing atmospheric nitrogen for the plant in specific root structures known as nodules.[5]

**Role of Plant Growth Promoting Rhizobacteria for Plant Growth Enhancement**

PGPR plays an important role in enhancing plant growth through a wide variety of mechanisms. The mode of action of PGPR that promotes plant growth includes (i) abiotic stress tolerance in plants; (ii) nutrient fixation for easy uptake by plant; (iii) plant growth regulators; (iv) the production of siderophores; (v) the production of volatile organic compounds; and (vi) the production of protection enzyme such as chitinase, glucanase, and ACC-deaminase for the prevention of plant diseases [10,23]. However, the mode of action of different PGPR varies depending on the type of host plants [9]. Plant growth is influenced by a variety of stresses due to the soil environment, which is a major constraint for sustainable agricultural production. These stresses can be classified into two groups, biotic and abiotic. Biotic refers to the stresses due to plant pathogens and pests such as viruses, fungi, bacteria, nematodes, insects, etc., while abiotic is stresses due to the content of heavy metal in soils, drought, nutrient deficiency, salinity, temperature, and so on.[5]

PGPR has the ability to increase the availability of nutrient concentration in the rhizosphere by fixing nutrients, thus preventing them from leaching out. As an example, nitrogen, which is needed for the synthesis of amino acids and proteins, is the most limiting nutrient for plants. The mechanisms by which atmospheric nitrogen is added into organic forms that can be assimilated by plants are exclusive to prokaryotes]. A rare example of a free-living nitrogen-fixing organism is Azospirillum, often associated with cereals in temperate zones and also reported to be able to improve rice crop yields . Some PGPR have the ability to solubilize phosphate , resulting in an increased availability of phosphate ions in the soil, which can be easily taken up by the plants. Kocuria turfanensis strain 2M4 isolated from rhizospheric soil was discovered to be a phosphate solubilizer, an IAA producer, and a siderophore producer .[5]

**DEFINE SALITY STRESS + TYPES+ MODE OF ACTION**

**THEN,**

**EFFECT OF SALINITY ON SEED GERMINATION**

During their growth crop plants are usually exposed to different environmental stresses which limit their growth and productivity. Among these, salinity and drought are the most severe ones. It has been estimated that more than 20% of all cultivated lands around the world contain salt levels high enough to cause salt stress to crop plants. In saline environment adaptation of plants to salinity during germination and early seedling stages is crucial for the establishment of species. Seedlings are the most vulnerable stage in the life cycle of plants and germination determines when and where seedling growth begins . There are contradictory reports in the literature as to the relative sensitivity of germination and seedling growth to salt stress. According to Munns , salt stress decreases growth in most plants, including halophytes. Salt stress affects many physiological aspects of plant growth. Shoot growth and dry matter are reduced by salinity, root: shoot ratio is increased. Miquel et al., documented, that respiration decreases under water stress condition, though decrease in respiration is much less than photosynthesis. It was also proven that salt stress increases the activity of an alterative pathway along with the cytochrome pathway. Salinity can affect germination of seeds either by creating osmotic potential which prevent water uptake, or by toxic effects of ions on embryo viability. Shoot growth was reduced by salinity due to the inhibitory effect of salt on cell division and enlargement in the growing point. Nevertheless, the relative importance of osmotic and ionic effects on early growth of halophytes is still incomplete and depends on the species under study. Many studies on seedling growth response to salt stress have used seedlings pre-germinated under non-saline conditions. This approach may provide a clear separation of effects, but could give an unrealistic view of the response of seeds to saline types. Improving salt tolerant varieties is of major importance and efforts should be focused on finding mechanisms which are involved in salinity tolerance . This may induce us to find methods for screening a large number of genotypes for salt tolerance. Studies with seeds and early seedlings are carried out mostly with Triticum aestivum L. and Prosopis strombulifera. The majority of salt stress studies have used NaCl as experimental salt. Few research works have recently reported results on the effects of Na2SO4 on germination and plant growth. The aim of the present study was to evaluate the effect of monosaline iso-molar solutions of NaCl and Na2SO4 salinity at germination and early seedling growth stage.[6]

**NOTE:-**

1. **CORRECT THE REFENCES**
2. **ARRANGE AS PER THE COMMENTS**
3. **ALWAYS PERFORM THE COMMENTS IN A NEW WORD FILE**
4. **KEEP THE REFERENCE FILE SEPARATELY.**
5. **TAKE THE HELP OF SHAHNAAZ IF POSSIBLE. SHE WILL HELP YOU IN ASSISTING IN A BETTER WAY.**

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