Study on the impact of *pseudomonas fluorescence* and organic matter for the growth of *capsicum annum* as a potential biofertilizer

Harsha Sharma[1]*, Kalpana Sharma[2]

[1*,2]Research Scholar, Professor, Department of Microbiology, Faculty of Science, Motherhood University, Roorkee, India

***Corresponding Author:** Harsha Sharma
*Research Scholar, Department of Microbiology, Faculty of Science, Motherhood University, Roorkee, India
E-Mail: vashishthaharsha5@gmail.com

Abstract
There are hundreds of species of hazardous pests and disease-causing micro-organisms in the area of agricultural ecosystems, but there are also hundreds of species of helpful companions of farming insects and useful microorganisms including fungal, bacterial, and viral organisms. These clever crop pests are fed by pathogenic bacteria and, like a quiet soldier, perform a crucial role in pest control. Which can be put to good use in pest control and has the potential to be a well-rounded, long-lasting, and inexpensive tool for doing so. When microorganisms are used to suppress pest populations, the process is known as microbial control. Finding and breeding more of a pest's natural enemies could improve their efficacy in biological management, therefore it's important to keep an eye out for them. An innovative method of biological management, this strategy makes use of naturally occurring microorganisms that are spread by the targeted pests. Which is accessible from people who are competent in marking and is also extremely easy to get at, basically, we are able to tackle this issue in such a way that it may be fixed. To disseminate the word about the benefits of organic farming, the researchers must maintain their emphasis on the phrase "organic" and actively participate in outreach programs.

Keywords: Agriculture sustainability, antibiotic bacterium, biofertilizer, organic matter, plant immunity.

Introduction

On the one hand, organic gardening encompasses the more "hands-on" aspects of cultivating things like fruit and vegetables. On the other hand, it savors the ethical aspect of gardening, which is where people are concerned with issues like global warming, the water problem, the destruction of animal habitats, and the loss of biodiversity. (Zhuang XL, *et. al.,* 2007) This article will explain how an organic garden may be a solution to these problems by using a variety of techniques, including water storage containers, the use of grey water, drip watering, mulching, the recycling of kitchen trash, and the provision of appropriate habitat for various types of animals. (Balandreau J, 2002) An essential component of the ecosystem that supports agriculture is the existence of a certain number, however, restricted, of species that are detrimental to agricultural production. Farmers have to be aware of the fact that the population of beneficial microorganisms in farming will be impacted even if detrimental microorganisms are eliminated. (Shoebitz M, *et. al.,* 2009) Using an all-encompassing strategy called integrated pest management (IPM), farmers may keep the populations of harmful organisms to a minimum. (Kennedy IR, *et. al.,* 2004) This method takes full use of the options at hand. Microorganisms are crucial to the growth of organic farming in agriculture because of their contributions to the improvement of food production, environmental protection, and ecological balance. Future agricultural pest control will also rely heavily on the use of microorganisms. Grains can be grown without the use of harmful pesticides if farmers start using these microbes instead. (Goldstein AH, *et. al.,* 2007)

Plant growth-promoting rhizobacteria, which refers to a group of helpful bacteria that colonize the rhizosphere (the area of soil surrounding plant roots) and are useful to the development and overall health of plants. These bacteria form a symbiotic or mutualistic relationship with plants, giving the host a number of advantages including increased nutrient intake, protection against infections, and higher tolerance to stress. (Delvasto P, *et. al.,* 2008) It has been shown that PGPR may have a number of beneficial impacts on plants, including the following:

1. Nutrient Mobilization and Solubilization: PGPR may assist in the solubilization of nutrients such as phosphorus, which makes them more accessible for plants to take up.
2. Nitrogen Fixation: Some PGPR has the capacity to fix atmospheric nitrogen into a form that plants can utilize, therefore supplementing plant nitrogen requirements.
3. Production of Plant Growth Regulators: PGPR is capable of producing hormones and growth-promoting chemicals that encourage plant growth and development.
4. Biocontrol: Certain PGPR may prevent the development of harmful bacteria in the rhizosphere, providing a natural

form of disease control.
5. Enhanced Stress Tolerance: PGPR may help plants survive a variety of environmental challenges, such as drought, salt, and severe temperatures.
6. Improved Soil Structure: PGPR may make a contribution to the aggregation and structure of the soil, which, in turn, increases the soil's ability to retain water and nutrients.
7. Induced Systemic Resistance: PGPR may activate the plant's inherent defense systems, making the plant more resistant to diseases and pests. (Goldstein AH 2007)

In recent years, there has been a rise in interest in the use of PGPR in agricultural and horticultural settings as a method that is both sustainable and kind to the surrounding ecosystem, with the goal of maximizing plant growth and yield. In order to take advantage of the potential advantages offered by the many strains of PGPR being researched, researchers are continuing their investigations into the relationships between these strains and the various plant species. (Hayat R, *et. al.*, 2010) It is essential to keep in mind that while PGPR may confer major benefits on the development of plants, the extent to which they do so is very variable and is determined by a variety of variables, including the particular strains of PGPR that are applied to the plants in question as well as the plant species and soil conditions in question. (Kokalis-Burelle N 2003)

The phenomenon known as biological control is something that occurs naturally in ecosystems. Which can be utilized effectively in the management of pests, and has the potential to be a balanced, sustainable, and cost-effective instrument for the management of pests. Microbial control refers to the practice of using microorganisms in order to manage insect populations. (Murray JD, *et. al.,* 2007) When natural enemies of pests are employed for the microbiological control of pests and their numbers are increased, the natural enemies of pests may be used for the control of pests. (Mantelin S, *et. al.,* 2004) This is a novel component of biological control, and it involves the use of microbes that are carried by pests in order to do this. Which is available from those who are skilled in marking and is also very simple to get at, fundamentally speaking, we are able to handle this problem in such a manner that it can be resolved. (Roesti D, *et. al.*, 2006) It is vital to decide the time of the application of microorganisms carefully on the weakening of the life cycle of the insect. This is done in order to prevent any complications. It is important that they be kept in a cool and dry location. (Lee S, *et. al.*, 2002)

Bacteria in the soil play a significant role in the biogeochemical cycles and have been used for crop development for many years. The plant's health and the fertility of the soil are both determined by the plant-bacterial interactions that take place in the rhizosphere. It is possible for free-living soil bacteria that are advantageous to plant development to promote plant growth by colonizing the plant root. These bacteria are often referred to as plant growth-promoting rhizobacteria, or PGPR for short. In addition to their more common names, PGPR is also known as plant health-promoting rhizobacteria (PHPR) and nodule-promoting rhizobacteria (NPR). (Panwar JDS, *et. al.*, 2000) These are connected to the rhizosphere, which is an essential component of the ecological environment of the soil and plays a vital role in plant-microbe interactions. Among the cyanobacteria known as symbiotic nitrogen-fixing bacteria are the genera Rhizobium, Bradyrhizobium, Azorhizobium, Allorhizobium, Sinorhizobium, and Mesorhizobium. It has been shown that free-living nitrogen-fixing bacteria or associative nitrogen fixers, such as bacteria belonging to the genera Azospirillum, Enterobacter, Klebsiella, and Pseudomonas, may adhere to the root and colonize root surfaces in an effective manner. (Paynel F, *et. al.*, 2001) PGPR has the potential to make a contribution to the development of sustainable plant growth. In general, the functions of PGPR may be broken down into three categories: the synthesis of specific chemicals for the plants, the facilitation of the plant's absorption of certain nutrients from the soil, and the reduction or elimination of illnesses that affect the plants. Direct and indirect influences on plant growth and development may both be beneficial. Direct influences can help promote plant growth. Indirect plant growth promotion activities include minimizing the damage caused by organisms that might cause phytopathogens (plant diseases). (Raj SN, *et. al.*, 2003)

Producing siderophores, or tiny compounds capable of binding metals, is one method for accomplishing this goal. In addition, the production of antibiotics and the biological control of soil-borne plant diseases have both been attributed to various different bacterial species. The synthesis of hydrogen cyanide (HCN) and/or enzymes that degrade fungal cell walls, such as chitinase and ß-1,3-glucanase, is yet another way in which PGPR might impede the growth of phytopathogens. (Miller RM, *et. al.,* 2000) Auxins, cytokinins, gibberellins, ethylene, and abscisic acid are some of the plant hormones that are produced during the process of direct plant growth promotion, which may occur either symbiotically or non-symbiotically. (Russo A, *et. al.*, 2008) A number of different bacterial species have been reported to produce indole-3-ethanol or indole-3-acetic acid (IAA), both of which are chemicals that belong to the auxin family. Some PGPR operates as a sink for 1-aminocyclopropane-1-carboxylate (ACC), the immediate precursor of ethylene in higher plants, by hydrolyzing it into ketobutyrate and ammonia. As a result, they stimulate root development by reducing indigenous ethylene levels in the micro-rhizome environment. Enhancing resilience to stress, improving soil structure and organic matter content, stabilizing soil aggregates, and PGPR may all be accomplished thanks to the solubilization of mineral phosphates and other nutrients. PGPR is able to keep more organic soil nitrogen and other nutrients in the plant-soil system, which reduces the need for fertilizer nitrogen and phosphorus and improves the release of the nutrients. (Saleem M, *et. al.*, 2007)

Biofertilizers are natural or organic chemicals that include live microorganisms, such as bacteria, fungi, or algae. These microorganisms aid in increasing the amount of nutrients that are available to plants as well as the efficiency with which plants can absorb these nutrients. (Park KS, *et. al.,* 2000) The presence of these microorganisms, which either develop symbiotic relationships with plants or boost the ecology of the soil, results in an increase in the fertility of the soil and the growth of plants. Biofertilizers are an alternative to chemical fertilizers that are believed to be more sustainable and environmentally friendly. This is due to the fact that biofertilizers are able to contribute to the health of the soil and minimize the environmental consequences. (Shah Z, *et. al.,* 2003)

There are several kinds of biofertilizers, each of which performs a particular function:
1. "Nitrogen-Fixing Biofertilizers," Also Known as These include nitrogen-fixing bacteria such as Rhizobium, Azotobacter, and Azospirillum, which may transform atmospheric nitrogen into a form that plants can consume, hence lowering the need for synthetic nitrogen fertilizers.
2. Phosphorus-Solubilizing Biofertilizers: These include microorganisms such as phosphate-solubilizing bacteria (PSB) and mycorrhizal fungi, both of which assist to solubilize bound phosphorus in the soil, making it more accessible to plants.
3. Biofertilizers that may mobilize potassium: Microorganisms capable of facilitating the release of potassium from mineral sources in the soil may increase the amount of this nutrient that is available to plants.
4. Biofertilizers that Encourage Plant Growth and Development: These include a wide variety of helpful microorganisms, such as plant growth-promoting bacteria (PGPR) and fungi, which stimulate plant development by increasing nutrient intake, creating growth-promoting chemicals, and increasing the plant's tolerance to stress.
5. Biofertilizers as a Means of Disease Prevention: Some biofertilizers include helpful bacteria that help reduce plant infections and illnesses by either outcompeting harmful microbes or activating plant defense systems. This helps the biofertilizer do its job.
6. Azolla Biofertilizer: Azolla is a kind of tiny fern that grows in water and has the ability to collect nutrients and fix nitrogen from the air. Rice paddies often make use of it as a means of boosting the fertility of the soil.
7. Algal biofertilizers: When they are integrated into the soil, some forms of algae may contribute to the fertility of the soil by fixing nitrogen and supplying organic matter. (Vivas A, *et. al.,* 2005)

The natural activities of the plant are supported by the use of biofertilizers, which are normally applied to the soil or the plant's surface. They have the power to enhance the structure of the soil, increase the availability of nutrients, and generally boost plant health. (Zaidi S, *et. al.,* 2008) However, the efficacy of biofertilizers may change depending on a variety of circumstances, including the kind of crop being grown, the environment, the soil, and the management techniques used. It is essential to keep in mind that while biofertilizers have a number of advantages, they could not present the same level of quick nutrient release as chemical fertilizers do. As a consequence of this, they are often used as a component of a holistic approach to sustainable agriculture, alongside other methods for the management of soil. (Richardson AE 2001)

Materials and Method

In emerging nations such as Pakistan, the daily need for chemical fertilizers is significantly increasing throughout the whole year. The soil's microflora and fauna, as well as the environment, water supply, and human health, are all negatively impacted by the use of chemical fertilizers, which also drives up production costs and contributes to contamination of the environment and water supply. Therefore, it is of the utmost importance to discover an alternative to these potentially harmful compounds. Rhizobacteria that promote plant development, also known as plant growth-promoting rhizobacteria (PGPR), are a diverse collection of bacteria that quickly colonize the rhizosphere and provide either direct or indirect protection to agricultural plants. (Saravanakumar D, *et. al.,* 2008) The application of PGPR to the seeds not only resulted in a notable increase in the rate of seed germination but also defended the seeds against the growth of harmful microbes. It has been shown that the capacity of many crops to absorb nutrients and water and increase their yields may be considerably improved with the use of PGPR. (Matiru VN, *et. al.,* 2004) The potential benefits of PGPR include the establishment of symbiotic relationships with other beneficial microorganisms, an increase in the rate of nitrogen fixation, and an increase in the supply of primary, secondary, and micronutrients. Scientists find PGPR to be an intriguing component of research, and these days there are a variety of formulations of PGPR that are accessible for purchase in the marketplace. A large number of scientists provided evidence that PGPR plays a function in the promotion of growth. This analysis reveals that PGPR may serve as an effective alternative to potentially harmful chemical fertilizers in order to promote environmentally friendly and sustainable agricultural practices.

In general, this research aimed to evaluate the “Study on the impact of pseudomonas fluorescence and organic matter for the growth of capsicum annum as a potential biofertilizer.” which required mainly the following materials:

- Strain of bacteria
- Plant species
- Organic matter solution

Plant species

To begin, we will collect 5 healthy plants (*Capsicum annum*), of which one will act as the control plant. The experimental plants will be observed and compared to the control plant.

Biofertilizer composition	**Treatment**	**Symbol**
Pseudomonas fluorescence + organic solution	Control with 03 plants	T1
Pseudomonas fluorescence + organic solution	*Capsicum annum* (Chili)	T2
Pseudomonas fluorescence + organic solution	*Capsicum annum* (Chili)	T3
Pseudomonas fluorescence + organic solution	*Capsicum annum* (Chili)	T4

Table No. 1.1: Biofertilizer composition and treatment detail.

Bacterial strain

For the purpose of this experiment, many different strains of bacteria that had previously been isolated from the soil around the rhizosphere of *Dalbergia sissoo* were used. The procedures listed below were used in the process of characterizing the Pseudomonas fluorescence strains:

- Growth study
- Gram staining

Indole Production

The isolates' overnight cultures were used to inoculate sterile Hydrogen Sulphide-Indole-Motility agar (SIM agar) slants or Tryptophan broth tubes, which were then put in an incubator at a temperature of 28 degrees Celsius for 48 hours. After the time spent in the incubator, ten drops of Kovac's indole reagent were added to each tube. This followed the incubation step. Isolates that produced a red color were deemed to be positive for indole production because of this characteristic (Beneduzi A, *et. al.*, 2008).

Solution for organic matters

- A Native cow urine will be used to fill the first twenty liters of the container.
- Twenty liters of cow urine were mixed together with human urine, which was done by combining around 2.5 kg of Margo leaves.
- In a similar manner, two kilos worth of harebell leaves were pulverized and added to this combination.
- In addition to that, this combination contains between 250 and 500 grams of acid leaves.
- 250-500 grams of powdered chili
- The liquid that is strained from part of the cucumber leaves should be added to this combination.
- Tobacco powder weighing between 500 and 750 grams.

Observation

Measure the height of the plant, the total number of branches, and the plant's weight.

Treatment and dosage considerations

- In the plant that is being used as a control, consistently provide clean water.
- In water purification facilities 1-2 grams in a solution of biofertilizer for every liter.
- There are no negative consequences associated with taking an excessive amount of a substance.

After thoroughly combining all of these components, let the mixture be exposed to sunshine for around 15 days, then pour it into the container; from this point on, the biofertilizer will not get rotten.

After going through filters, this solution may then be sprayed using low-pressure watering nozzles, such as fan nozzles, or other forms of watering systems, such as drip systems. Alternatively, it can be dripped onto plants. The first spray should be applied to a healthy plant 20 days after it has been transplanted. The second spray should be applied 35 days after the first transplant, and the third spray should be applied 50 days after the initial transplant. It also has a beneficial impact on our agriculture and produces fantastic outcomes; hence, we are now able to develop organic farming by using cutting-edge materials and techniques.

Result and discussion

Control plant measurement

Weight: - 6.0 cm
Number of Branches: - 04
Weight of Plant: - 2.0 kg with fruit
Treatment Plant after transplantation shown by the graph

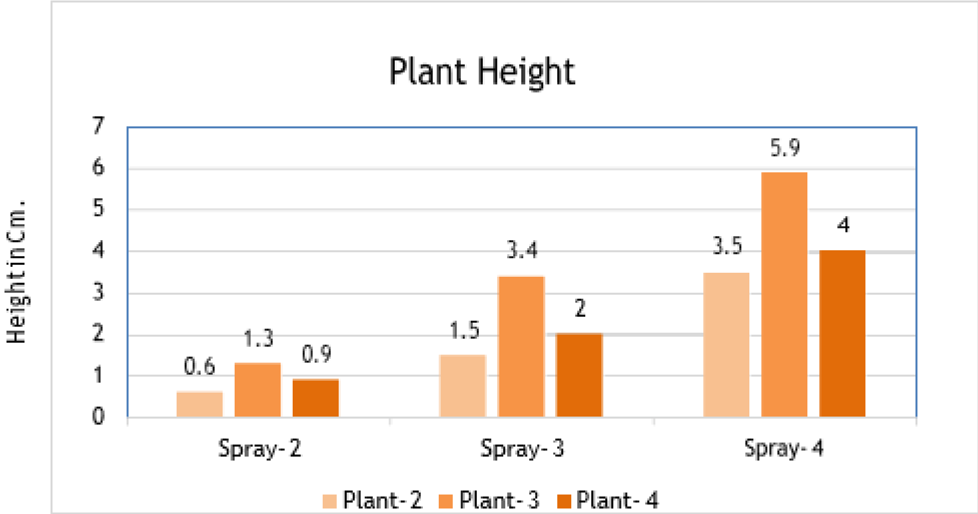

Fig. No. 1.1 : Plant Growth graph after spray

Number of total branches

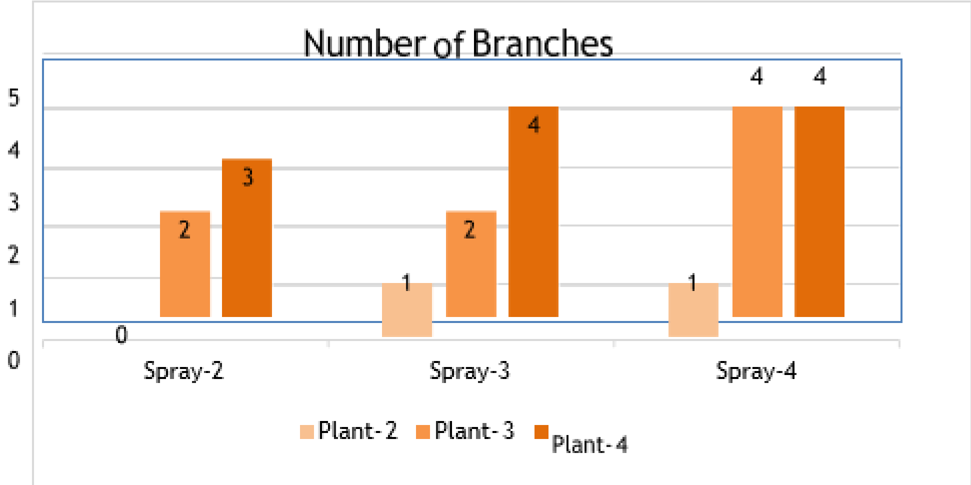

Fig. No. : 1.2: Total number of branches on the plant after spray

The total amount of weight with fruit
Plant No. 2- 1.3 kg
Plant No 3- 1.1 kg
Plant No. 4- 2.3 kg

Conclusion

These microorganisms do not have any toxin-like effects on the environment or the crops; instead, they have certain properties that cause them to be destructive to the insects that they are aimed. It has been shown that the development of immunity in insects is reduced with their usage, and the use of these insects may also control insects that are not killed by typical pesticides since they are safe for the beneficial pests of farming. A lower overall production cost may be seen as a direct result of the use of the bare minimal quantity in said cost. In the event that the agricultural ecology is not modified, a constant growth in the number of them will be useful in preventing the spread of pests. (Dell' Amico E, *et. al.*, 2008) They are compatible with the use of insecticides as well as organic goods. Insect conservation of insects in agriculture and in their natural biological form, we can control insects through pest-free agriculture in which our assistive insect consists of a mite insect circle primarily in the Trichoderma sp. which is a Micro-organism, which helps to free the disease by eating mildew. The preservation of insects, both in agricultural settings and in their native, biological forms. Pseudomonas fluorescens is a strain of bacteria that may be cultured in the laboratory to produce an antibiotic. It has the ability to consume the most common problems, such as root mucus and fungal diseases that may be seen in crops.

In addition to being an antibiotic bacterium, Bacillus subtitles are mostly found in the process of barley seed treatment. This treatment helps boost the germination percentage by decreasing the number of seeds used. In order to meet the demands of the world's ever-increasing population by the year 2050, the objective for food production will need to be increased by 50 percent while at the same time reducing reliance on artificial fertilizers and pesticides. In order to accomplish this objective, it will be required to do research on a wide range of topics that are mutually beneficial, including plants and microorganisms. Because of their helpful actions, their consumption of vital nutrients, and their involvement in the growth of branches and roots, microorganisms are becoming more significant. (Igual JM, *et. al.*, 2001)

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