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Research Article

"*Pseudomonas fluorescens*" as an Antagonist to Control Okra Root Rotting Fungi Disease in Plants

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The common bacteria found in fruit and vegetables are *Pseudomonas fluorescens* which is Germ-negative and is rod-shaped. *Pseudomonas fluorescens* has been originated from the rhizosphere of Roorkee-grown okra. The presented work involves recognizing and controlling the isolates of *Pseudomonas fluorescens*. The scope of the proposed work is that the technique used here is a unique strategy to plant protection and control of rotting fungus diseases based on the recognition and management of *Pseudomonas fluorescens* isolates. Antagonist effect occurs commonly in vegetable and fruit plants. The main goal of this study is to isolate, identify, and evaluate the development of these bacteria which effects on plant growth. In this research work, five isolates have been chosen for further research based on their morphological, biochemical, and physiological characteristics. All five isolates have been identified as *Pseudomonas fluorescens* from Bergey's Manual for the determination of bacteriology. Catalase, urease, amylase, and citrate utilization test were all positive in all of the isolates. PFTT4 was identified to be a likely strain for all plant growth promoting exercises such as age of IAA, HCN, ammonia, and phosphate solubilization subsequent to being assessed for their plant development advancing properties. Further, in vitro exploring uncovered that PFTT4 diminished the development of phytopathogens such as *Fusarium solani* and extraordinarily further developed seed germination just as all development boundaries like shoot and root length. Furthermore, *Pseudomonas* sp. PFTT4's plant growth promoting and antifungal activities put forward to it could be there used because of bioinoculant agents for *Abelmoschus esculentus*.

1. Introduction

For plant health, the rhizosphere (the area of soil around and enveloping the plant root) is crucial. *Pseudomonas* is an important rhizosphere chemical, and a specific strain, together with lady finger, has been demonstrated to boost plant physical condition in a variety of crops. Pseudomonads are being researched intensively over the world to determine if they can be employed as crop protection and soil health maintainers. They are the bacterial groups in the rhizosphere with the most metabolic and functional flexibility. Interactions between soil bacteria and plants in the rhizosphere can help, hinder, or impair plant growth. The growth and development of biological control agents as an alternative, ecologically friendly technique for protecting agricultural and horticultural crops against bacterial and fungal diseases have sparked attention due to environmental and customer concerns. Furthermore, protection against many illnesses is

necessary for plant and animal development. The initial effort to separate PGPR from the rhizosphere top soil of Roorkee-developed okra is depicted in flow. The rhizosphere provides an ideal home for soil microorganisms due to the high supplement accessibility via root exudates. The plant rhizosphere is an important soil biological environment for plant-microbe interactions. Contingent upon the sort of microorganisms, soil supplement status, protection framework, and soil climate, colonization through a scope of microbes in and around the roots can result in symbiotic, associative, naturalistic, or parasitic relationship inside the plant. Okra (*Abelmoschus esculentus*), a popular vegetable in many nations, has global economic and nutritional significance. This vegetable crop is widely produced and used for economical purposes on the planet. The pseudomonads are now being studied extensively over the world to see whether they can be used to protect groupings. Plant growth can be aided, delayed, or hampered by interactions between soil bacteria crops and preserve soil health. They are the rhizosphere's most metabolically and functionally flexible bacterial and plants in the rhizosphere.

Pseudomonads are the world's generally assorted and naturally applicable bacterial gathering. *Pseudomonas* strains secrete many of the chemicals such as gibberellins and solubilize phosphate, cytokinins, and auxins, they generate HCN and siderophores, and lytic enzymes stimulate plant development and are hence referred to be plant growth promoting rhizobacteria. All nonpathogenic rhizobacteria and a few separates of *Pseudomonas aeruginosa*, *Pseudomonas aureofaciens*, *Pseudomonas fluorescens*, and *Pseudomonas putida* smothered soil-borne microorganisms by creating optional metabolites, for example, antitoxins, protease, HCN, and siderophore. The rhizobacteria is enhancing plant development while also acting as biocontrol agents which might be a feasible solution. According to various researches, pseudomonads have been found to protect okra from infections that cause illness.

Vegetable developing spaces of the world, *Fusarium* spp. and *Rhizoctonia solani,* are significant soil-borne contagious contaminations of both nursery and field created ladies fingers, causing cataclysmic sicknesses, for example, root spoils and shrink, and at last diminished yield creation and quality. Chemical fungicides are mostly used to combat these infections. However, the widespread use of these chemicals poses a threat to the environment as well as human health.

As a result, alternate techniques to plant disease control should be highlighted. Plant growth promoting rhizobacteria with biocontrol capacity could be a viable option. Pseudomonads have been shown to prevent pathogens that cause disease in okra, according to several. The goal of this study was to seclude, distinguish, and assess the development advancing and adversarial impacts of a few *Pseudomonas fluorescens* effects on okra plants in Roorkee, India.

2. Materials and Method

2.1. Isolation of Pseudomonas Fluorescens from the Rhizospheric Soil. Okra seedlings were tenderly eliminated from different fields in Roorkee; these all transported toward the laboratory into sterilized plastic bags. Until further processing, each one trial is kept into the refrigerator on 4°-5°C (showed in Table 1). Okra rhizospheric dirt was removed and dried by air. 1 gram of soil was weighed, and successive dilutions were performed before plating on King's *B* plates and incubating for 24–36 hours at 28°C. Pure cultures were kept for further use lying slant on NAM (nutrient agar medium) at 4°-5°C temperature [1].

2.2. Gram Staining for Identification. I took a clean slide and prepared thin smear of old culture be created and heat fixed. For about 1 minute, a couple of drops of precious crystal violet reagent are put on the smear. Using running tap water, I washed the slide. I used Gram's iodine to flood the smear and let it sit for 2 minutes. Drop by drop, ethyl alcohol (95%) was used to decolorize the stain. For 2–4 minutes, I poured a few drops of safranine. I washed the slide in faucet water and mount it in oil emulsion or glycerine before taking a gander at it under a magnifying lens (microscope) [2].

2.3. CT (Catalase Test). A drop of hydrogen peroxide (30%) was applied to the test culture on a clean slide, and the reported to result of bubbles was seen [3].

2.4. IP (Indole Production) Test. After autoclaving, each bacterial culture was injected separately in test tubes containing 5 ml tryptone broth. One test tube was preserved when in charge of, with no bacterial culture inoculated. 1 ml of Kovac's reagent was added to each tube, including the control, after 48 hours of incubation. After a 10–15-minute break, the tubes were gently moistened. [4] To allowing the reagent to rise to the top, the tubes were allowed to stand [5].

2.5. MRVP (Methyl Red and Voges-Proskauer) Test. Before autoclaving, the MRVP broth prepared and 6 ml of it were poured in each test tube. Four test tubes were kept as controls, and the bacterial culture was put into all of the others. The test was incubated at 28°–32°C for 24–48 hours. 05 drops of MR indicator were added to each test tube [6]. The control and the color change was observed. In the same way, for incubated test tubes and the control, 8–10 drops of Voges-Proskauer-I reagent and 2 drops of Voges-Proskauer-II reagent were used. The color change in the test tubes was observed and compared to the control [7].

2.6. CU (Citrate Utilization) Test. Simmon's citrate agar slants were formed and the bacterial culture was streaked on them. For 36–48 hours, the tubes were incubated at 28°–32°C. It was noticed that the slants' color changed [8].

2.7. Urease Production Test. Sticking an inoculating loop into the butt (bottom of the tube) and streaking the slants in a wavy pattern were used to inoculate urea agar slants [9]. The results were seen after 24 hours of incubation at 27°-28°C. The tubes were placed in front of a control.

Table 1: Morphological and biochemical characterization of *Pseudomonas fluorescens*.

Parameter	Isolates				
	PFTT1	PFTT2	PFTT3	PFTT4	PFTT5
Shape	Coccus	Coccus	Rod	Rod	Rod
Colonies	Circle	Circle	Circle	Circle	Circle
Colony growth	Slow growth	Fast growth	Slow growth	Fast growth	Fast growth
Colonies growth	Light greenish	Yellowish green	Yellowish green	Yellowish green	Light green
Gram staining	+	+	+	+	+
MR test	+	−	+	+	+
VP test	−	+	−	−	−
Citrate utilization test	−	−	−	−	−
Urease test	+	+	−	+	+
Starch hydrolysis test	−	−	+	−	−
Catalase test	+	+	−	+	+
Indole test	−	−	+	−	−
Carbohydrate fermentation					
Mannitol	+	+	+	+	+
Dextrose	−	+	−	−	+
Lactose	+	+	+	+	+
Sucrose	−	+	−	−	+

2.8. Starch Hydrolysis Test. Inoculated cultures were placed on starch agar plates and incubated at 28–30°C for 48 hours. Plates with healthy bacteria were soaked with iodine solution for 30 seconds using a dropper. The surplus iodine solution was poured out [10]. The result showed the formation of clear and clean zones around each isolate's line of growth, for example, a change in medium color.

2.9. CFT (Carbohydrate Fermentation Test). First, we took the tubes of broth that had been sweetened with 4 different color sweeteners (0.5% of each, for example, dextrose, mannitol, lactose, and sucrose); one Durham tube has been submerged in each tube [11]. The test culture tubes were cultured for 24–26 hours at 28°–30°C. Signs of acid or gas generation, such as a change in color or the creation of bubbles, were examined for in the tubes.

2.10. IAA (Indole Acetic Acid) Production. Mansoor's description of IAA manufacturing was confirmed (2007) [12]. L-Tryptophan (0.1 g/l) was injected into bacterial colonies in nutrient broth. At 4°C, exponentially growing cultures were centrifuged for 15 minutes at 10000 rpm [12]. Two drops of Salkowski reagent were added to the supernatant (2 ml) (1 ml of 0.5 M $FeCl_3$ in 50 ml of 35 percent $HClO_4$). The appearance of pink color confirmed the presence of IAA.

2.11. Phosphate Solubilization. The capability of isolates to solubilize phosphate was tested using Pikovskaya's agar plates [13]. The plates were checked and used for the appearance of clearing zones surrounding the colonies after 4 days of incubation at 281°C (appropriate to solubilization of inert phosphate by producing macrobiotic acid by microorganisms).

2.12. Zinc Solubilization. Zinc solubilization by microbes was carried out according to Sayyed's method (2005) [6]. The bacteria were identified using Tris-minimal media plates containing zinc phosphate and a pH indicator called bromophenol blue [14].

2.13. HCN Production. Modified approach was used to determine HCN production (2010). Isolates' exponentially growing cultures (108 cells/ml) were streaked on solid agar plates supplemented with 4.4 g glycine/I, filter paper soaked in 0.5% picric acid in 1% Na_2CO_3 added to the upper lid of the plates at the same time [15]. Para film was used to seal the plates. After 48–72 hours of incubation at 281°C, the hue changed from yellow to light brown, sensible brown, or strong brown, indicating possible HCN production [16, 17].

2.14. Ammonia Production. A bacterial isolate will be tested in peptone water to see if it can generate ammonia. 48-hour-old cultures were incubated in 08 ml peptone water and incubated at 28°–30°C for 70–72 hours [18, 19]. On the culture broth over the slide, 0.5 mL Nessler's reagent was applied. A yellow to brown precipitation emerged within a few minutes, indicating moderate to high ammonia production Chen et al. [20].

2.15. Antagonistic Activities. The development of secluded strains contrary to the parasitic infection *Fusarium solani* was measured using a dual culture approach (MTCC 3871) [21, 22]. Agar blocks (5 mm in diameter) were inserted in the centre of the assay plate from the margin of a 5-day-old fungal pathogen culture. One loop (24-hour-old) isolated strain culture founded 02 cm away from the pathogen. Plates were incubated for 3–7 days at 281°C [23]. The hindrance zone was determined utilizing the recipe: inhibition zone (rate) = 100C−T/C, where C addresses spiral development in charge and T addresses outspread development in double culture Aarab et al. [24].

2.16. Bacterization of Seed. Bacterial strains (PFTT1–PFTT5) were refined in supplement stock for 48 hours in a shaker at 281°C. At 4°C, the cultures were centrifuged for 15 minutes at 8000 rpm. To achieve a final population density of 1 108 cells/ml, the way of life supernatants were disposed of and the pellets were washed and suspended in sterile refined water. Independently, bacterial cell suspensions were joined with 1% CMC answers for structure slurry, which was then covered on the outer layer of seeds. Okra seeds covered with a 1% CMC slurry were utilized as a manage.

2.17. Germination of Seed. For the pot examine, sterile nursery soil was utilized. The dirt was ground into fine particles before being sanitized in a 160°C broiler for 2 hours. Okra seeds were gathered from the Roorkee neighborhood market. We picked solid seeds that were comparative in structure and size in sets of three, bacterized seeds were planted in the pots. Seeds treated with just 1% CMC were utilized as a benchmark grouping. As necessary, the pots are watered. The following were the treatments: T1, *Pseudomonas* spp. bacterized seeds PFTT1; T2, *Pseudomonas* spp. bacterized seeds PFTT2; T3, *Pseudomonas* spp. bacterized seeds PFTT3; T4; *Pseudomonas* spp. bacterized seeds PFTT4; T5, *Pseudomonas* spp. bacterized seeds PFTT5. Up to 21 DAS, root weight, shoot length, shoot weight, root length, and germination percentage were considered.

3. Result

3.1. Isolation of Pseudomonas fluorescens. Rhizobacteria samples were secluded from okra using King's medium and a serial dilution approach. On the basis of early investigation, total 5 isolates (PFTT1, PFTT2, PFTT3, PFTT4, and PFTT5) were examined. The urease, citrate utilization, catalase production, and MRVP synthesis all were positive, whereas indole production was negative in all five. Furthermore, IAA production was reported in all isolates, with PFTT5 exhibiting the brightest pink hue. The experiment's outcomes are depicted in a variety of tables and flowcharts. It was discovered that PFTT4 may be used as bioinoculants for okra and other harvests because it has excellent plant growth and boosting properties such as IAA age and phosphate solubility.

3.2. Gram Staining and Morphological Characteristics. Isolate colonies form is described as spherical and yellow green in color. Gram negative and rod-shaped isolates were discovered in every case.

3.3. Biochemical Characterization. The whole of the disengaged (PFTT1, PFTT2, PFTT3, PFTT4, and PFTT5) were observed to be positive for urease, citrate usage, and catalase creations and starch hydrolysis however was negative for indole creation and MRVP creation (Table 1).

3.4. Indole Acetic Acid Production. IAA production was discovered in all five *Pseudomonas* spp. isolates (PFTT1, PFTT2, PFTT3, PFTT4, and PFTT5). The deepest pink color produced by PFTT5 indicated the highest indole acetic acid production (Table 2).

3.5. Phosphate Solubilization and Zinc Solubilization. On Pikovskaya's agar plate, all of the confines are fit to make clear corona around the spot vaccination. Phosphate solubilization ability was demonstrated in such clearing zones around the bacteria (Table 2). Because there were no halo zones around the colonies, not any of the isolate was capable to solubilization of zinc (Table 2).

3.6. HCN and Ammonia Production. Aside from PFTT3, the whole disengage of *Pseudomonas fluorescens* framed HCN is shown through a change in channel paper tone. As shown by the serious earthy colored shade of the pass through a channel paper, PFTT4 delivered the most HCN (Table 2). In peptone stock, all of disengage produced alkali by creating yellowish earthy colored accelerates (Table 2 and Figure 1).

3.7. Antagonist Activity. The whole of the *Pseudomonas* disconnects were tried for *Fusarium solani* opposing action. The development of test microorganisms on PDA plates at 28°C was stifled by *Pseudomonas* spp. PFTT4. The term of hatching compares to an expansion in parasitic restraint. Following 7 days of hatching, *Pseudomonas* spp. PFTT4 had the option to obstruct 42% of *Fusarium solani*, as per the normal outspread development restraint rate (Table 2).

3.8. Pot Trial Studies. Pseudomonas spp. disconnects were utilized to bacterize okra seeds of uniform shape and size (PFTT1 to PFTT5). Following 22 days of planting in pots, seeds closed up with the aforementioned microbial inoculants showed initiated vegetative qualities. *Pseudomonas* sp. PFTT4 had the best seed germination, shoot, and root length. Shoot new and dry weight, just as root new and dry weight, showed comparative expansion propensities. The medicines with *Pseudomonas* spp. PFTT1, PFTT4, and PFTT5 delivered the best number of plants. *Pseudomonas* sp. PFTT4 bacterized okra seeds brought about an extensive expansion in seed germination rate (82.2%), trailed by PFTT5 (75.8%). Seed germination was 40% in the control treatment (Table 3). In contrast with the control, each of the measurements was upgraded and was huge at 1% and additionally 5%. Figure 2 shows the graph scale of *Pseudomonas fluorescens* effect on seed germination and vegetative growth of okra.

In a pot trial investigation, okra seed bacterized with *Pseudomonas fluorescens* PFTT5 showed critical expansion in shoot length, root length, and dried shoot and root weight. PFTT4 and PFTT5 treated seeds germination rates were 83.3 percent and 76.7 percent, separately.

4. Discussion

Flow research depicts the starting exertion finished to isolate PGPR from the rhizospheric top soil of Roorkee-developed okra. Due to the high supplement accessibility as root

Table 2: Plant growth promoting activities of *Pseudomonas fluorescens and Abelmoschus esculentus.*

Isolations	IAA	Zinc solubilization	Phosphate solubilization	Ammonia production	HCN production	Antagonist
PFTT1	+	++	−	−	+	−
PFTT2	++	+	−	++	+++	+
PFTT3	++	+	−	+	+	−
PFTT4	+	++	−	−	+	−
PFTT5	++	+	−	++	+++	+

A−, IAA positive; IAA negative, +, B−, +, phosphate solubilization positive, −, phosphate solubilization negative, +, little radiances <0.5 cm wide encompassing provinces; −, absence of corona development; ++, medium coronas >0.5 cm wide encompassing settlements; +++, enormous radiances >1.0 cm wide encompassing states.

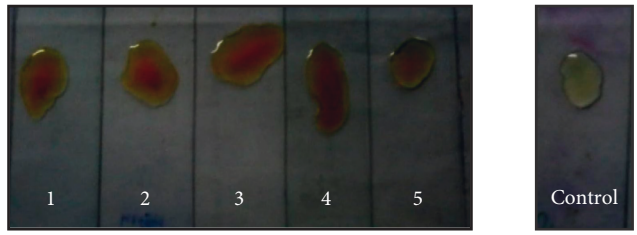

Figure 1: Plant growth promoting activities of *Pseudomonas fluorescens.*

Table 3: *Pseudomonas fluorescens* effect on seed germination and vegetative growth of okra.

Isolates	Seed germination (%)	Root length (cm)	Shoot length (cm)	Root weight (g)		Shoot weight (g)	
				Fresh wt.	Dry wt.	Fresh wt.	Dry wt.
PFTT1	65.7	3.567^{*}	4.80^{**}	0.0210^{*}	0.1^{**}	0.232^{**}	0.10^{*}
PFTT2	62.5	4.325	3.465^{**}	0.016^{**}	0.012^{**}	0.215^{ns}	0.90^{ns}
PFTT3	60.00	3.68^{**}	3.44^{**}	0.112^{ns}	0.006^{ns}	0.186^{ns}	0.103^{*}
PFTT4	82.2	5.896^{**}	4.322^{**}	0.32^{*}	0.012^{**}	0.432^{*}	0.117^{**}
PFTT5	75.8	4.100^{ns}	3.400^{**}	0.018^{ns}	0.007^{*}	0.240^{ns}	0.220^{*}
Control	39.0	55.7	2.57^{*}	4.70^{**}	0.210^{*}	0.01^{**}	0.22^{**}
SEM		52.5	4.25	2.45^{**}	0.16^{**}	0.011^{**}	0.25^{ns}
CD at 1%		060.0	3.867^{ns}	3.444^{**}	0.0112^{ns}	0.006^{ns}	0.186^{ns}
CD at 5%		65.7	3.567^{*}	4.25^{**}	0.21^{*}	0.01^{**}	0.23^{**}

SEM = standard blunder mean; CD = critical differences. values are mean of 3 arbitrarily chose plants from each set; **huge at 01%; *huge at 5% when contrasted with control; NS = nonhuge when contrasted with control (nonfactorized seeds).

exudates, the rhizosphere gives an optimal environment to soil microorganisms. The number of inhabitants in organic entities that live in a given climate is special and is impacted by the physical and natural components that exist in that climate. Additionally, Patel et al. utilized King's medium to extricate 10 fluorescent pseudomonad strains from assorted rhizospheric soil of yield plants such as rice, maize, and bazar [11]. Kumar et al. recognized 115 *Pseudomonas fluorescens* isolates from the rhizosphere of soybean in Cirebon, Plumbon, Indonesia [5]. All of the detaches tried positive for catalase, citrate use, urease age, and starch hydrolysis, yet negative for indole blend and MRVP.

IAA production was discovered in all of the isolates. In PBRI, Haridwar, India, bacteria that produce indole acetic acid have been shown to stimulate root elongation and plant growth. The development of natural acids, for example, gluconic, acidic, lactic, fumaric, and succinic acids is connected to phosphate solubilization by bacterial separates. The easiest way of plant bacterial identification is physical evaluation of crop heredity and set up of appropriate samples. Through this way, we can easily detect and diagnosed plant diseases. But, the modern techniques such as AI play crucial role in detecting the plant diseases in early stages and diagnosed in time.

Natural corrosive amalgamation brings down soil pH, bringing about the age of H^{+}, which replaces Ca^{2+} and discharges HPO_4^{2-}into the dirt arrangement. *Pseudomonas* and *Bacillus* were recognized as the essential phosphate solubilizes by Ashrafuzzaman et al. [21]. Immunization utilizing phosphate solubilizing microbes further developed maize development and grain yield, cut compost uses, and brought down ozone depleting substance outflows, as per Mandal et al. [13]. As per Verma et al., 70% of their detached is suitable for solubilize phosphate in the scope of 5.8 to 13.45 mg/100 ml and advance chickpea improvement [3]. These investigations back up our decision.

Except for PFTT3, all detaches that twisted the shade of the channel paper from yellow to orange-brown were assigned HCN makers [4]. *Pseudomonas* spp. produces HCN, which represses the development of phytopathogens, as per Saad [8]. The plant growth promoting activities play an important role for the development of plant through many ways. Plant growth can be aided, delayed, or hampered by interactions between soil bacteria crops and preserve soil

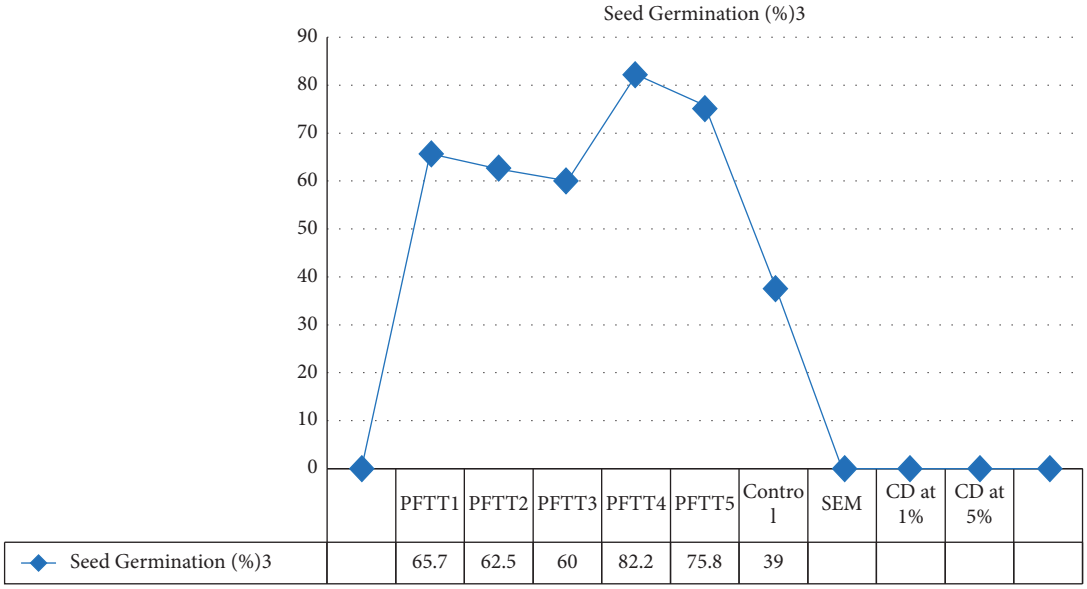

Figure 2: Graph scale of *Pseudomonas fluorescens* effect on seed germination and vegetative growth of okra.

health. Furthermore, in vitro studies revealed that PFTT4 inhibited the growth of phytopathogens such as *Fusarium solani* and significantly improved seed germination, as well as all development parameters such as shoot and root length.

HCN is a wide range antibacterial atom occupied with organic control of root contaminations by various plant connected fluorescent pseudomonads, as indicated by León et al. [25]. In this examination, every one of the disconnected life forms was observed to be acceptable smelling salt makers. Also, Kaur and Sharma discovered smelling salts age in 95% of *Bacillus* secludes and 94.2 percent of *Pseudomonas* disconnects, which upholds our discoveries [15]. The shading changes from brown to yellow tone were a positive test for alkali creation [11].

PFTT4 was observed in the direction of suppressing *Fusarium solani* growth (in vitro) in our investigation. Wahyudi et al. found that *Pseudomonas* spp. have antifungal efficacy against *Fusarium solani* [2]. Mansoor et al. discovered that using *P. aeruginosa* and *P. lilacinus* alone or in combination effectively controlled *F. solani*. In the benchmark group, only 40% of seeds developed (uninoculated seeds) [12]. These discoveries are like those of Sayyed et al.'s who found that immunizing wheat seed with *P. fluorescens* NCIM 5096 expanded the pace of germination by 10% [6]. Ashrafuzzaman et al. showed an increment in seed germination when rice seeds were pretreated with plant growth promoting rhizobacteria detaches [21]. Likewise asserting this, plant growth promoting rhizobacteria worked on nut development and seed rise.

As a consequence, alternative plant disease control approaches should be promoted. Rhizobacteria that enhance plant development while also acting as biocontrol agents might be a feasible solution. According to various researches, pseudomonads have been found to protect okra from infections that cause illness. Regarding plant-microbe interactions, the plant rhizosphere is a crucial biological habitat in the soil. Colonization by a variety of microbes outside the roots can result in a symbiosis, associative, naturalistic, or parasitic interaction within the plant, depending on the kind of microorganisms, soil supplement status, protective framework, and soil temperature.

Therefore, it is feasible to presume that *Pseudomonas* spp. bacterial strains will gather more consideration in the field of biofertilization and natural control due to their multifunctional capacities. *Pseudomonas* spp. (PFTT4), which have great plant development boosting characteristics such as IAA age, phosphate solubilization, HCN creation, alkali creation, and biocontrol, could be utilized as bioinoculants for okra and different harvests, as per the current review [20].

5. Conclusion and Future Scope

Due to environmental and consumer concerns, the development of biological control agents as an alternative, environmentally acceptable strategy for safeguarding agricultural and horticultural crops against bacteria, and fungi diseases has generated interest. Moreover, the growth of plants and animals depends on protection from various diseases. *Pseudomonas fluorescens* is a Germ-negative, rod-shaped bacterium commonly found in fruits and vegetables. *Pseudomonas fluorescens* has been derived from the rhizosphere of Roorkee-grown okra. The work provided here focuses on identifying and managing *Pseudomonas fluorescens* isolates. The presented work is a novel approach towards protection and to control rotting fungi diseases in plants by recognisation and controlling the isolates of *Pseudomonas fluorescens*. The entire focus of the study is to seclude, distinguish, and assess the development advancing the impacts of these bacteria on plant growth. Five different isolates were chosen which are based on their morphological, biochemical, and physiochemical characteristics. These are PFTT1, PFTT2, PFTT3, PFTT4, and PFTT5. All five were observed to be positive for urease, citrate usage, catalase

creation, and MRVP creation, however, negative for indole production. Moreover, IAA production was discovered for all isolates and it was found that deepest pink color was observed in PFTT5. The results of the experiment have been illustrated though various tables and flowcharts. It was observed that PFTT4, having great plant development and boosting characteristics such as IAA age and phosphate solubilisation, can be used as bioinoculants for okra and different harvests. However, further understanding of the components involved, as well as the signaling interaction between antagonist, pathogen, soil, and plants is required in the future to promote biocontrol agents as broadly applicable biofertilizers.

Data Availability

The data shall be made available on request.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

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