Unravelling the Role of PGPR "*Pseudomonas fluorescens*" in Semi-Arid Soils of the Rio Grande Valley

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Abstract

Plant Growth promoting Rhizobacteria (PGPR) are plant beneficial free-living bacteria which are found in rhizosphere and rhizoplane of various plants. *Pseudomonas fluorescens*, a PGPR, helps in plant growth and promotion either through direct or indirect mechanisms. In this study, 35 isolates of *P. fluorescens* isolates from the rhizosphere of sunn hemp (*Crotalaria juncea*), a warm season annual legume, from a certified organic farm in sub-tropical south Texas were screened with in King's B (KB) media and comprehensively profiled for plant growth promotion trait such as production of indole acetic acid (IAA), hydrogen cyanide, siderophore, ammonia, ACC (1-Aminocyclopropane-1-Carboxylate) deaminase, phosphate, zinc and protease solubilization. Our result showed out of 35 isolates, all 35 isolates were able to produce siderophore, IAA and Ammonia, 22 isolates were able to solubilize phosphatase, 20 isolates were positive for protease production, 13 isolates were able to produce ACC deaminase, 25 isolates tested positive for HCN production, while none of the isolates were able to solubilize zinc. The study of secondary metabolite profiling of *P. fluorescens* in connection to plant development will reveal an effective biofertilizing and biocontrol agent in Rio Grande Valley.

Introduction

Plant growth-promoting rhizobacteria (PGPR) are beneficial plant bacteria that are found in the rhizosphere and rhizoplane of the plants that colonize plant roots and enhances plant growth in various environmental stress conditions [1]. Among many PGPR, *P. fluorescens* is one of the most studied PGPR [2]. *P. fluorescens* is a gram negative, rod shaped bacterium which belongs to the *Pseudomonas* genus. *P. fluorescens* are known to promote and facilitate the plant growth by both direct and indirect mechanisms. Direct plant growth promotion includes the production of IAA, ACC deaminase, ammonia and protease. *P. fluorescens* are also known to solubilize insoluble phosphate and made readily available to the plant. Indirect plant growth promotion includes the protection and prevention of plant against various plant pathogen by producing siderophores, antibiotics, hydrogen cyanide (HCN) [3]. Currently, there are no known reports on the study of local *P. fluorescens* isolates in Lower Rio Grande valley. Here in this study, I am screening and characterizing plant growth promoting traits of *P. fluorescens* from the rhizosphere of Sunn hemp (*Crotalaria juncea*).

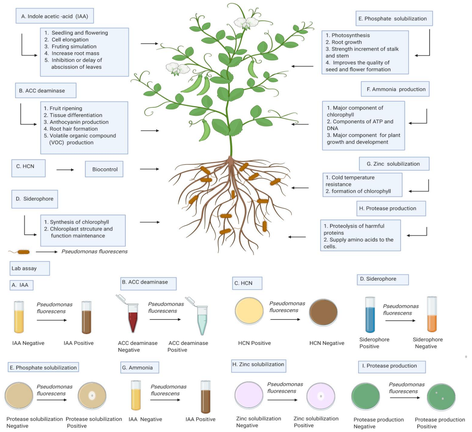

Figure 1. Role of *P. fluorescens in* plant growth and performance/experiment of different assays to determine plant growth promoting potential of *P. fluorescens* in vitro.

Methods

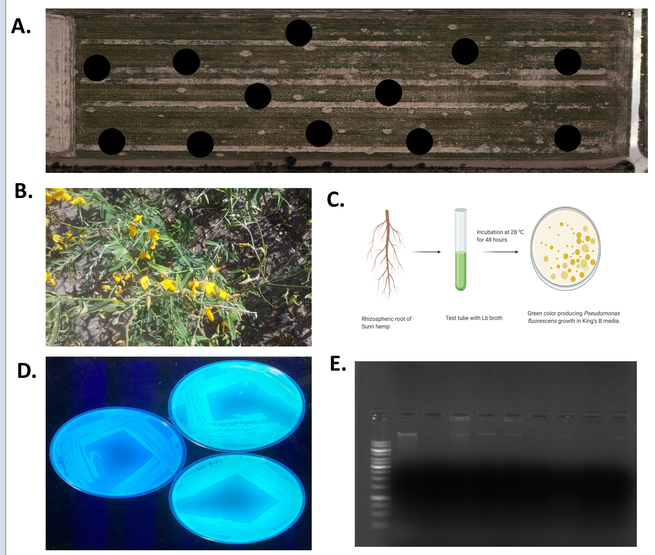

Figure 2. Samples were collected from rhizospheric soil of Sunn hemp from hilltop garden, Texas (A, B). 35 different isolates of *P. fluorescens* were isolated in King's B media by incubating at 28 ^{0}C for 48 hours (C, D). Eight different microbial assays were performed to determine the best bacterial strains [4]. Currently we are extracting genomic DNA from all 35 isolates for 16 S rRNA sequencing (E).

1. IAA and ACC deaminase production

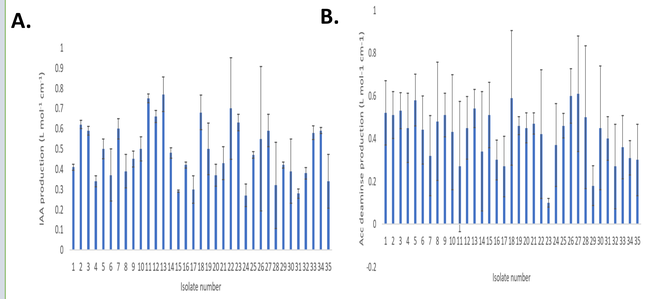

Figure 3. Quantitative study of IAA (A) and Acc deaminase (B) production by *P. fluorescens.* Out of 35 isolates, all 35-isolates produce IAA, and 13 isolates were able to produce ACC deaminase. Both experiments were triplicated.

2. Ammonia production

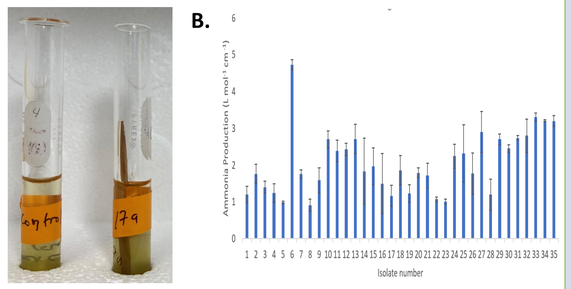

Figure 4. Study of Ammonia production by *P. fluorescens.* Out of 35 isolates, all 35 isolates showed positive result for ammonia production. Qualitative (A) and Quantitative (B) results are shown. Experiment was triplicated.

3. Protease production

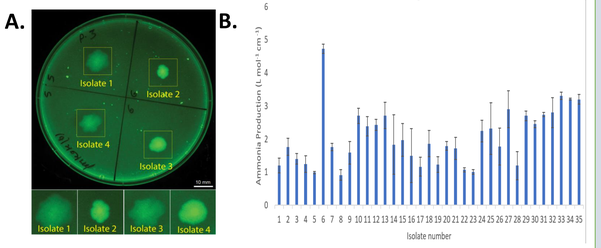

Figure 5. Study of protease production by *P. fluorescens.* Out of 35 isolates, 20 isolates produced protease. Qualitative (A) and Quantitative (B) results are shown. Experiment was triplicated.

4. Phosphate solubilization

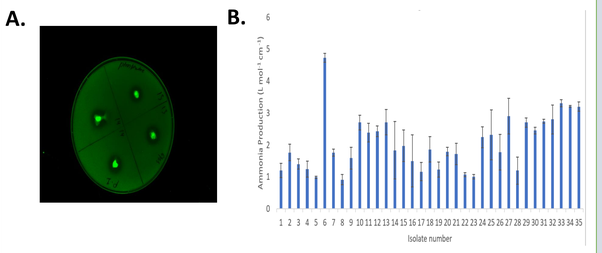

Figure 6. Study of phosphate production by *P. fluorescens.* Out of 35 isolates, 22 isolates solubilized phosphate. Qualitative (A) and Quantitative (B) results are shown. Experiment was triplicated.

5. Siderophore and HCN production

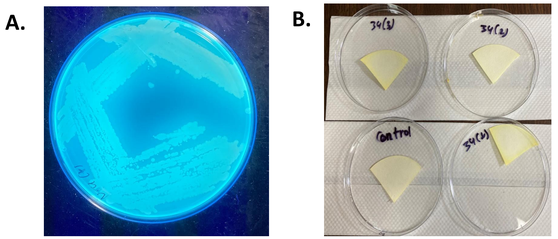

Figure 7. Qualitative study of siderophore (A) and HCN production (B). Out of 35 isolates, all the isolates showed positive result for siderophore production , and 25 isolates were able to produce HCN. Both experiments were triplicated.

Summary

Out of 35 isolates, all 35 isolates were able to produce siderophore, IAA and Ammonia, 22 isolates were able to produce phosphatase, 20 isolates were positive for protease production, 13 isolates were able to produce ACC deaminase, 25 isolates tested positive for HCN production, while none of the isolates were able to solubilize zinc.

Conclusion

Our study showed that the *P. fluorescens* isolated from the rhizosphere of Sunn hemp plant produced many plant beneficial compounds and this *P. fluorescens* bacteria has potential to be used as biofertilizing and biocontrol agent to enhance the plant growth and development in arid and semi arid regions.

References

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