The Pharma Innovation Journal 2021; 10(8): 1631-1634

www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277- 7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2021; 10(8): 1631-1634

www.thepharmajournal.com
Received: 17-06-2021
Accepted: 23-07-2021

P Sharma
SCS College of Agriculture, AAU, Rangamati, Dhubri, Assam, India

GK Upamanya
SCS College of Agriculture, AAU, Rangamati, Dhubri, Assam, India

K Das
SCS College of Agriculture, AAU, Rangamati, Dhubri, Assam, India

R Brahma
SCS College of Agriculture, AAU, Rangamati, Dhubri, Assam, India

Corresponding Author:
P Sharma
SCS College of Agriculture, AAU, Rangamati, Dhubri, Assam, India

Evaluation of efficacy of PGPR in suppression of Bacterial wilt of tomato

P Sharma, GK Upamanya, K Das and R Brahma

Abstract
A pot experiment was carried out at Department of Plant Pathology, SCS College of Agriculture, Rangamati Dhubri during 2019-20. In the present investigation applications of different talc based microbial consortia formulations of PGPR were made as seed treatment, root treatment and soil application against bacterial wilt of tomato. The highest reduction of bacterial wilt incidence (90.18%) and highest yield (1.516 kg/plant) of tomato was recorded in treatment comprising of *T. viride*+ *P. fluorescens* + *B. subtilis*.

Keywords: Evaluation, efficacy, PGPR, Bacterial, Bacterial

Introduction
Tomato (*Lycopersicon esculentum* Mill), has very high nutritive values, delicious taste and is one of the most popular and widely grown vegetables in the world with production of 162.520 lakh MT in an area of 4.813 lakh ha with productivity of 33.8 MT/ha, (Annon., 2014) [1]. India is the second largest producer of tomato in the world with a production of 19007 thousand MT in an area of 781 thousand ha with of productivity 25.00 MT/ha, which share 11.2 per cent of total vegetable production (Annon., 2019) [2]. Assam ranked 14th in all India level with 396.24 thousand MT of tomato production in an area of 18.28 thousand ha and productivity of 21.67 MT/ha (Annon., 2019) [2].

There are more than 200 known tomato diseases of diverse nature and etiology in many parts of the world. Among these diseases, bacterial wilt caused by *Ralstonia solanacearum* Yabuuchi *et al.* (erstwhile *Pseudomonas solanacearum* E. F. Smith), is the predominant limiting factor and loss in yield due to bacterial wilt varies between 10.8 and 90.6 per cent depending on environmental condition (Kishun, 1987) [4]. In Assam prevalence of *R. solanacearum var. asiaticum* was first reported by Hingorani *et al.*, 1956 [3]. Since then wide spread occurrence of bacterial wilt have been recorded in all vegetable growing areas, which assumes serious proportion particularly in the years when environmental conditions favours the outbreak of the disease. Different management practices of the disease have been suggested by many workers including use of chemicals, antibiotics, soil amendments, soil solarization etc. Management of the bacterial wilt disease by single control measure seems to be a difficult proposition due its wide host range as well its long survival ability in soil. Applications of chemicals and antibiotics have been prescribed for management of the disease, but most of these have limitations. Chemicals also exert serious effects on non target beneficial organisms and consequently hazardous threat to environment. Under these circumstances, integrated disease management warranting exploration of non-chemical methods, such as biological agents, plant products, host plant resistance, soil amendments with limited use of chemical pesticides seems to be a better option.

With the above background, the present investigation was made to evaluate a biointensive management strategy of bacterial wilt of tomato using various bioactive microorganisms and their consortia, against bacterial wilt of tomato and corresponding enhancement of plant growth and yield attributes.

Methodology
Efficacy of selected PGPRs and their consortia in management of bacterial wilt of tomato in pot
Three PGPR having good compatibility with each other were selected for this study to find out the efficacy against *R. solanacearum*

Crop – Tomato
Cultivar – Pusa Ruby
T1= *T. viride* + *P. fluorescens* + *B. subtilis*
T2= *P. fluorescens* + *B. subtilis*
T3= Biofor Pf-2
T4= Control
Design = CRD
Replication = 5

Method of application of bioformulations

The substrate based bioformulation of *Trichoderma* sp., *Pseudomonas* sp., and *B. subtilis* were applied as seed treatment, root dip treatment and soil application methods.

For seed treatment, paste slurry of each substrate based formulation was prepared by mixing 100 g of the formulation in 200 ml of water. To these paste slurry, tomato seeds were dipped @ 1000 seed/100 ml of paste solution for 1 hr to coat the seeds with the formulations. The coated seeds were then removed from the slurry and spread over a paper in cool and dry place (under shade for overnight) for drying. Treated seeds are then sown in the tomato nursery.

For root treatment, each of the substrate based formulations was mixed with water @ 20 gm in 1000 ml to prepare 2 per cent bioformulation solution. At the time of transplanting uprooted plants from nursery were root dipped (@1000 seedlings/1000ml) in the solution for 1 hr. Treated seedlings were dried under shade for 1 hr before transplanting in to earthen pots.

For soil application, each of the substrate based formulations was mixed with soil contained in earthen pots @ 5% solution. The mixture was applied @ 100 ml/pot (containing 20 kg of garden soil) after 15 days of sowing, at the base of the plants. After application of the formulation, it was kept under net house to protect from direct exposure to sunlight.

Disease record

The number of wilted plants was recorded throughout the experiment. The data were tabulated and disease incidence (DI%) was calculated by the following formula:

$$\text{Disease Incidence (\%)} = \frac{\text{No. of wilted plant}}{\text{Total no. of plants}} \times 100$$

Yield record

The yield of each treatment (kg per plant) was recorded at harvest.

Statistical analysis

Statistical analysis was decided according to the objective of the present study. The frequencies, percentage, mean and standard deviation was calculated to answer the various questions relevant of the objectives to the study. Laboratory and field experiment data were subjected to the statistical analysis (Snedecor and Cochran, 1967). The significance of a given variance was determined by calculating the "F" values. The standard error of difference of treatment means (S.Ed±) was calculated. The CD (Critical Difference) was performed to test the significance of difference between pairs of means for various observations.

Completely Randomized Design (CRD) and Fisher's method of analysis of variance was employed for statistical analysis of the collected data of the experiments. Significance of variance among data was calculated out by calculating 'F' values and comparing with appropriate values of 'F' at 5 per cent probability level.

For statistical analysis, the data on per cent values were transformed into corresponding angular values or log values wherever necessary. To compare the different treatments among themselves, critical differences were calculated out. Standard error of differences was calculated out by using the formula:

$CD = S.Ed. \times t_{0.05}$ for error degrees of freedom

$$S.\,Ed = \sqrt{\frac{2 \times \text{Error mean square}}{\text{No. of replication}}}$$

Where, S.Ed = Standard error of difference
$t_{0.05}$ = Table value of "t" at 5 per cent probability level.

To establish the relationship between disease incidents with yield in experimental pots, the data were subjected to correlation studies. The correlation co-efficient (r) was calculated using the formula:

Results and Discussions

Efficacy of different PGPR and their consortia based formulations in management of bacterial wilt of tomato

The results relevent to effect of different combinations of *T. viride*, *P. fluorescens*, and *B. subtilis* based bioformulations with talcom powder as substrate are presented in Table 1. Bioformulations were applied as combinations of seed, root and soil treatment for management of bacterial wilt of tomato. The effect of bioformulations of was also compared with efficacy of Biofor-Pf 2 applied as seed, root and soil treatment.

From the data it is evidant that the disease incidance of tomato decreased significantly accompanied by significant increase of yield (kg/plant) in plants treated with consortia of different bioactive microorganisms. Lowest disease incidence was exhibited by the bioformulation consotia of *T. viride* + *P. fluorescens* + *B. subtilis* was significantly highest (9.82%) followed by *P. fluorescens* + *B. subtilis* (13.42%) and Biofor-Pf 2 (15.01%) applied as seed treatment, root treatment and soil treatment. Plants untreated with bioformulation showed highest disease incidence (82.00%).

The yield of tomato treated with consortia of different bioactive microorganisms folowed similar trend as recorded for disease incidence. Significantly highest yield (kg/plant) was recovered from plants treated with bioformulation consortia of *T. viride* + *P. fluorescens* + *B. subtilis* (1.516kg/plant) followed by *P. fluorescens* + *B. subtilis* (1.448 kg/plant) and Biofor-Pf 2 (1.340 kg/plant) applied as seed treatment, root treatment and soil treatment. Plants untreated with bioformulation showed lowest yield (0.389 kg/plant). The effect of different bioformulation consortia on disease incidence and yield of tomato are presented in Table 1

Table 1: Effect of talc based formulations of PGPR on bacterial wilt incidence and yield of tomato

Treatments	Disease incidence (%)	Disease reduction (%)	Yield (kg/plant)	Yield increase over control (%)
T1	9.82 (18.26)*	90.18	1.516	310.84
T2	13.42 (21.48)	86.58	1.448	292.41

T3	15.01 (22.79)	84.99	1.340	274.53
T4	82.00 (64.91)		0.389	
S.Ed.(±)	0.409		0.065	
CD (0.05)	0.693		0.095	

* Data in the parenthesis are angular transformed values

The disease incidance of tomato decreased significantly accompanied by significant increase of yield (kg/plant) in plants treated with consortia of different bioactive microorganisms. Lowest disease incidence was exhibited by the bioformulation consotia of *T. viride* + *P. fluorescens* + *B. subtilis* (4.04%) followed by *T. viride* + *P. fluorescens* (10.27%), *P. fluorescens* + *B. subtilis* (12.96%) and Biofor-Pf 2 (15.01%) applied as seed treatment, root treatment and soil treatment. Plants untreated with bioformulation showed highest disease incidence (82.26%).

The yield of tomato treated with consortia of different PGPR folowed similar trend as recorded for disease incidence. Highest yield (kg/plant) was recovered from plants treated with bioformulation consortia of *T. viride* + *P. fluorescens* + *B. subtilis* (1.516 kg/plant) followed by *P. fluorescens* + *B. subtilis* (1.448 kg/plant) and Biofor-Pf 2 (1.340 kg/plant) applied as seed treatment, root treatment and soil treatment. Plants untreated with PGPR formulations showed lowest yield (0.389 kg/plant).

Application of the PGPR along with substrate like talc powder and additives like CMC, mannitol, etc., significantly reduced the disease incidence and increased yield in tomato. The increase in yield and decrease in disease incidence might be due to suppression of the pathogen due to application of bioactive microorganisms.

Rudresh *et al.* (2004) [7] reported that combined inoculation of biocontrol agent *Trichoderma* sp. and beneficial organisms like Phosphorous solubilizer and nitrogen fixer improved the growth of chickpea. Similarly, the study of Srivastava *et al.* (2010) [8] on use of consortium of arbuscular mycorrhizal fungus, *T. harzianum* and fluorescent *Pseudomonas* formulation for the management of tomato wilt found significant reduction of disease in field along with enhanced growth and yield of tomato. Srinivasan and Mathivanan (2011) [9] also recorded significant reduction in the pre-and post- emergence disease incidence and increased the germination per cent in cabbage and cauliflower seedlings treated with Pathogens + Azotobacter sp. + *B. megaterium* + *P. fluorescens* + *B. subtilis* + *T. harzianum*. Similarly, Sateesh and Sivasakthivelan (2013) [10] reported that co-inoculation of *P. fluorescence* in consortium with *T. viride* and *A. chroococcum* was significantly better than dual and single inoculation in enhancing the growth and yield parameters of chilli as well as improvement in the soil health. Maina *et al.* (2013) [5] reported that the consortia of PGPRs and biocontrol agents enhanced the establishment of seedlings in the field. Researches of Phukan *et al.* 2016 indicated that Plant Growth Promoting Rhizobacterial inoculation enhanced growth and development of tomato crop.

A significantly highest number of fruits were also recorded with the highest average fruit weight (54.00 g) and highest fruit weight per plant (1.85 kg) when co-inoculated with all the PGPR. Sudharani *et al.* (2014) [11] evaluated the effectiveness of selected biocontrol agents in combination with PGPR s against damping-off and wilt pathogens of cabbage crops and found that the combination of *A. chroococcum* + *B. megaterium* + *P. fluorescens* + *B. subtilis* + *T. harzianum* showed enhanced seedling vigour, total biomass, least disease incidence and more biocontrol efficiency.

The result obtained in the present study in reduction of bacterial wilt disease and corresponding increased in yield are found to be similar with the findings discussed above. Therefore, the biointensive package developed by exploiting various fungal and bacterial antagonists, plant growth promoting rhizobacteria *viz*., *T. viride*, *P. fluorescens*, *B. subtilis* and *A. chroococcum* can be successfully utilized for management of bacterial wilt disease along with growth promotion and higher yield.

However, precise studies should be further made under farmers' field condition for determination their efficacy in disease management along with better plant growth and soil health and the subsequent monetary benefits the farmers will achieve by using these bioformulation. Moreover, there is need to develop a single complete package for overall management of other serious problems of tomato and increase yield. Further research on compatibility and incorporation of efficient potash solubilising microorganisms and other micronutrient solubilising micoorganisms can help to get a complete package for disease reduction and plant growth and yield.

References

1. Annonymous. Annual Report, Food and Agriculture Organization, Rome, Italy 2014.
2. Annonymous. Horticultural Statistics at a Glance 2018. Horticulture Statistics Division Department of Agriculture, Cooperation & Farmers' Welfare Ministry of Agriculture & Farmers' Welfare Government of India. 2019. https://agricoop.nic.in/
3. Hingorani MK, Mehta PP, Singh NJ. Bacterial brown rot of potatoes in India. *Indian Phytopath*. 1956;19:67-71.
4. Kishun R. Loss in yield of tomato due to bacterial wilt caused by *Pseudomonas solanacearum*. Indian Phytopath. 1987;40:152-155.
5. Maina CC, Shivaprakash MK, Devi TS. Establishment of tomato seedlings raised in the substrate enriched consortia of biocontrol agents and PGPRs. Mysore J agric. Sci. 2013;47(1):6-10.
6. Phukan A, Baruah R, Sharma P, Gogoi G. Plant Growth Promoting Rhizobacteria (PGPR) in Enhancing the Growth of Tomato (*Lycopersicon esculentum*). Advances in Life Sciences. 2016;5(16):6230-6233
7. Rudresh DL, Shivaprakash MK, Prasad RD. Effect of combined application of *Rhizobium*, phosphate solubilizing bacterium and *Trichoderma* spp. on growth, nutrient uptake and yield of chickpea (*Cicer aritenium* L.). Appl. Soil. Ecol. 2004;28:139-146.
8. Srivastava R, Khalid A, Singh US, Sharma AK. Evaluation of arbuscular mycorrhizal fungus, fluorescent *Pseudomonas* and *Trichoderma harzianum* formulation against *Fusarium oxysporum* f.sp. *lycopersici* for the management of tomato wilt. *Biol. Control* 2010;53(1):24-31.
9. Srinivasan K, Mathivanan N. Plant growth promoting microbial consortia mediated classical biocontrol of sunflower necrosis virus disease. J Biopesticides 2011;4(1):65 72.

10. Sateesh S, Sivasakthivelan P. Studies on the Influence of Bioinoculant Consortium on Chillies and Its Effects on Soil Health Management. Int. J. Chem. Tech. Res. 2013;5(3):1326-1328.
11. Sudharani M, Shivaprakash MK, Prabhavathi MK. Role of consortia of biocontrol agents and PGPRs in the production of cabbage under nursery condition. Int. J Curr. Microbiol. Appl. Sci 2014;3(6):1055-1064.