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# Biological control of diseases of solanaceous vegetable crops

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**Abstract**

Maximum losses in vegetables occur due to the attack of various pathogens like *Pythium* spp*., Fusarium* spp*., Rhizoctonia solani,* etc. The fungal and bacterial bioagents are useful in reducing the inoculum threshold of the pathogen there by reducing the disease incidence. Bio control agents can act as an alternative to pesticides in the management of various diseases. Bioagents can play the role of competition, parasitism, antibiosis and induce resistance. The effects of various bio control agent in the suppression of several plant diseases are well documented like *Trichoderma sp., Pseudomonas sp., B. subtilis Paecilomyces* spp*.*, and *Entrobacter sp.* have been found most effective in suppression of the diseases in potato, tomato, brinjal and chilli.

**Keywords:** Solanaceous vegetable, bioagent, *Trichoderma sp.*, management

## Introduction

Vegetables are important source of dietary, minerals and vitamins. All the developed and developing countries realize the importance of vegetables as an essential diet due to medicinal and nutritional value for human. The most popular garden plants in solanaceous crops include potato, tomato, brinjal and chilli. It is prone to diseases causing agents like fungi, bacteria, viruses and nematodes which affect them from seedling stage to harvest. Farmers use pesticides without knowing about the nature of diseases and pathogens involved. The indiscriminate use of pesticides becomes a limiting factor to meet out the international standards for export. It always results in certain level of toxicity in plant system and thus health hazards. It also disturbs complete ecology of soil, and microbial diversity of ecosystem. Frequent harvesting and raw consumption of vegetable further increase the risk factor. Under the situation application of bio agent in management of solanaceous vegetable diseases appears to be one of the most appropriate methods in production, so as to decrease the harmful effect of pesticide.

## Review of literature

### Potato

El-kot (2008) [15] indicated that *Trichoderma harzianum* @10ml /kg seed tuber significantly reduced the disease incidence of pre-emergence (5.1%), post-emergence (0.0%) and infection rate (2.6%) due to wilt of potato.

Basu (2009) observed that the *T. harzianum* @ 5 g/kg seed lowered disease severity (25.4%) with increase in percent efficacy in disease control (44.8%) followed by *Pseudomonas fluorescens* (26.7%) as compared to control (46.1%) against late blight of potato.

Al-Ani *et al.* (2013) [1] reported that the treatments of infected potato tubers with the *P. fluorescens* @$10^8$ cfu/ml induced significant restriction in PVY multiplication by low absorbance values on ELISA reaction (0.14) and significant reduction at the time of plant emergence (15 days) as compared to control (21 days).

Farkhondeh *et al.* (2013) [17] indicated significant reduction in Fusarium wilt (9.0%) in plots treated with *T. virens* @ 25 g/$m^2$ which was at par with *T. asperellum* as compared to control (24.66%).

Basahi (2014) [4] reported that the potato seed tuber treated with *P. monteilii* showed lower scab incidence in russet burbank (<1%) and prospect (10%). He also observed that the seed tuber treated with *P. chlororaphis* showed lower disease severity in russet burbank (18%) and, seed tuber treated with *P. brassicacearum* showed the lower disease severity in prospect (9%).

Chaudhary *et al.* (2015) [11] reported that the soil application of *T. harzianum* @ ( $1\times10^7$ cfu/ml) at the time of sowing, 20, 40 and 60 days after sowing gave the lowest stem canker index (36.10%), stolon canker (30.60%) and lower black scurf disease index (24.40%) in potato.

Murmu *et al*. (2015) [26] revealed that the bio control agent *T. viride* @ 4 g/l exhibited best results in terms of reduction in percent disease incidence (61.50%) of early blight of potato as compared to control (92.50%) with percent disease reduction (52.39%).

**Tomato**

Manoranjitham *et al*. (2001) [24] showed minimum pre- and post-emergence damping-off was 5.50 percent and 7.50 percent by soil application of *T. viride* (2.5 g) + *P. fluorescens* (2.5 g) as compared to control (24.75% and 26.50%) in tomato respectively.

Dutta and Das (2002) [14] studied the effect of *Trichoderma spp*. and chemicals on disease incidence against collar rot of tomato caused by *Sclerotium rolfsii* and recorded that application with *T. harzianum* + *S. rolfsii* show lowest disease incidence (39.7 %).

Anith *et al*. (2004) [2] found significantly lower (46.8%) bacterial wilt (*Ralstonia solanacearum*) by drenching of *P. putida* (5ml containing $5x10^8$ cfu/ml) + Actigard (28 mg/liter).

Mehra (2006) [25] recorded highest seed germination (74.0%), lowest pre-emergence mortality (26.0%) and lowest seedling infection (23.97%) with highest fusarium wilt control (71.5%) when *T. viride* was applied to tomato seedling.

Khiareddine *et al.* (2009) [23] recorded that the application of *T. harzianum* @ 3 ml/pot showed significantly lowest leaf damage index of wilt in tomato as compared to other treatments.

Nguyen and Ranamukhaarachchi (2010) [29] reported that antagonists showed significant reduction of bacterial wilt disease as compared to the control. Among them, *Entrobacter* sp. showed the highest disease suppression (12.5%) in tomato.

Constantinescu *et al.* (2011) [12] obtained the best control (90 to 88%) of damping-off (*Pythium ultimum*) and wilt (*F. oxysporum* f. sp. *radicis-lycopersici*) in tomato by application of *Bacillus subtilis* strains BS 98 ($10^8$ cfu/ml).

Khalil *et al.* (2012) [22] observed that *Paecilomyces lilacinus* @ 10g per plant was the most effective treatment to suppress the population density of the root knot nematode (85.22%) in soil which was followed by *Bacillus subtilis* (82.65%), *B. thuringiensis* (80.46%) and *Glomus macrocarpum* (80.14%), respectively.

Sundaramoorthy and Balabaskar (2012) [35] observed that the seedling dip and soil application of *Trichoderma* bioformulation (ANR-1) @ 0.2 % at 15 and 30 DAT showed least wilt incidence (15.33%) followed by KGI-3 (17.45%) as compared to control (57.75%). They also revealed that application of ANR-1 significantly increased plant height (73.62 cm) and fruit yield (288.38 gm).

Thakur and Tripathi (2015) observed highest reduction of disease incidence in fusarial wilt (47.4%) and buckeye rot (38%) by the application of FYM @ 200 q/ha + *Azospirillum* @4 kg/ha + PSB @4 kg/ha +*T. harzianum* @4 kg/ha.

**Brinjal**

Bohra *et al*. (2006) [8] studied the evaluation of bio control agents and neem formulations for management of damping – off in brinjal and chilli and recorded the highest seed germination per cent 85.0 and 57.5 and lowest incidence of disease 7.2 and 21.7 per cent in brinjal and chilli, respectively.

Haseeb and Kumar (2007) [19] recorded the effect of bio agents and organic amendments materials against *Fusarium oxysporum* on brinjal (cv. Pusa kranti) under pot conditions and found that bio agents *T. harzianum* and *T. viride* were most effective with 1.3 and 2.0 per cent root infection, only.

Biswas and Singh (2007) [7] noticed the effect of bio control agents on the control of bacterial wilt in brinjal (Var. Pongal Green) and observed that *P. fluorescens* @50g + 1kg cow dung / 5 $m^2$ plot was most effective in controlling the wilt with lowest wilt incidence (47.2 ± 6.9%).

Datar (2007) [13] recorded the effect of bio agents on the pre and post emergence damping off in eggplant cv. ABV-1 and found that *T. harzianum* (seed treatment (10g/kg) + soil application (20g/pot) was most effective in reducing both the pre emergence (10.66%) and post emergence damping off (8.0%).

Balai and Ahir (2011) [3] recorded minimum seedling mortality (9.3%) and disease intensity (38.5%) of leaf spot of brinjal with the application of *T. harzianum* @ $1\times10^4$ cfu/ml followed by *T. viride*.

Islaml and Meah (2011) [20] observed that seed treatment with garlic extract (1:1) showed lower incidence of damping off (0.0%) and seedling blight (0.0%) with higher germination (87.50%) followed by hot water treatment and *T. harzianum*.

Saha *et al.* (2012) [33] recorded that the application of *B. subtilis* strains AI01 @ 25 ml/pot showed lower disease index (24.7% and 23.9%) and highest PEDC (70.0% and 72.0%) after 8 and 16 days of inoculation.

Farfour and Ansary (2013) [16] showed the application of *Azotobacter chroococcum*, *B. subtillus*, *T. harzianum*, *A. chroococcum* + *T. harzianum* and *B. subtilis* + *T. harzianum* against root knot nematode. *A. chroococcum* @5 ml/pot was the effective treatment against *Meloidogyne incognita* (66.1%) followed by *T. harzianum* @5 ml/pot (63.2%), *B. subtillus* @5 ml/pot (60.5%), *A. chroococcum* + *T. harzianum* @2.5 ml/pot (58.3%), and *B. subtillus* + *T. harzianum* @2.5 ml/pot (44.9%), respectively.

**Chilli**

Ramamoorthy and Samiyappan (2001) [30] found that application of *P. flourescens* is most effective in reducing the fruit rot of chilli under field conditions with Per-cent disease index 20.93 and higher plant height (46.4 cm) and yield (22.5 t/ha).

Gupta *et al.* (2005) [18] suggested soil application of *T. harzianum* (500g multiplied in neem cake/ $m^2$) and spraying of *T. harzianum* (10 ml/lit.) for the control of wilt (*Fusarium oxysporum* f. sp. *capsici*) of bell pepper under protected cultivation.

Rini and Sulochana (2006) [32] recorded that the *T. harzianum* (TR20) @ 100g/pot was most effective in reducing disease incidence (22.9%) with yield (329.50 g/plant), plant height (55.00 cm) and shoot dry wt. (65.93 g), respectively.

Begum *et al.* (2010) observed that the treatment $T_4$ (*T. harzianum* IMI-392432 + *A. tenuis*) was most effective in reducing percent fruit rot infection (72.27%) with highest seed germination rate (85.56%) and yield (12.5g /plant) as compared to other treatment in alternaria fruit rot of chilli.

Ngullie *et al*. (2010) [28] studied the effect of antagonists on *Colletotrichum gloeosporioides* and found that *P. fluorescens* exerted the maximum inhibition (67.42%) of mycelial growth of the pathogen (2.16 cm compared to 6.63 cm in the control) followed by *T. viride* and *Bacillus subtilis* with an inhibition of 63.34 and 56.86% on mycelial growth (2.48 and 2.86 cm).

Chandra *et al*. (2010) [10] observed that the application of carbandezim (0.1%) gave the lowest disease index (0.990 ± 0.17%) which was at par with *P. aeruginosa* WS-1 @ 25ml per pot (1.363 ± 0.14%).

Srivastava *et al.* (2011) [34] studied the effect of bio-agents on colony growth of *Phytophthora capsici* causing Phytophthora blight of bell pepper *in vitro* and found that antagonist *T. viride* 1 and *T. harzianum* (PDBTH 10) were most effective with maximum per cent inhibition of pathogen 62.7 and 58.7, respectively.

Rehman *et al.* (2013) [31] observed that the seed treatment with *T. harzianum* @ 2.5 g/kg showed significant reduction in root-rot incidence (7.0%) in chilli.

Jain *et al.* (2014) [21] observed significantly lower (19.82%) damping off disease incidence with seed treatment of *P. fluorescens* 0.5% W.P. formulation @ 20g/ kg of seed.

Bora *et al.* (2015) recorded that the application of consortial formulation of *T. parareesei, T. viride, P. variotii, B. thuringiensis* and *Citrobacter farmeri* @10g/100g of seed resulted in lowest disease incidence (13.8%) and maximum disease reduction (83.87%). They also recorded significantly higher yield (96.8 qt/ha) as compared to other treatment combinations.

## Conclusion

From the foregoing discussion, it can be concluded that various diseases like wilt, blight, root knot nematode and viral diseases are common in potato, tomato, brinjal and chilli. Damping off is also a major concern in tomato, brinjal and chilli. Bioagents like *Trichoderma* spp., *Pseudomonas* spp., *Bacillus* spp., *Paecilomyces* spp., and *Entrobacter sp.* can be employed for the management of the diseases. Common practices like seed treatment, tuber and seedling dip treatment, soil application and spray with bioagents at various stages of the crop growth found to be one of the best way to manage the solanaceous vegetable diseases.

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