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Evaluation of TAIGRO (Bio-agents) against late blight of Tomato

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Abstract
Tomato late blight caused by *Phytophthora infestans* (Mont.) de Bary is a serious disease of tomato and potato worldwide. The disease causes severe crop losses in the tomato growing regions of the world. Most of the cultivars grown in the world are reported to be susceptible to late blight. Systemic fungicides have been used widely in the past, but the disease has developed resistance over time. The present study was carried out to minimize fungicide use through bio-agents (Bio-fungicides). Among the bio-fungicides tested, the treatment-NZBBA1106 @500g/500L of water/hawasfoundeffective (PDI 21.80%). The highest late blight disease severity was recorded in untreated control (PDI-50.25%). Overall the bio-fungicide treatment, NZBBA1106 @ 500g/ 500L of water/ha was found most effective treatment by showing 56.62% reduction in disease severity over control followed by NZBBA1106 @ 370g/ 500L of water/ha (53.83%).

Keywords: TAEGRO**,** PDI, *Phytophthora infestans*

Introduction
Tomato late blight caused by *Phytophthora infestans* (Mont.) de Bary, is a destructive disease of tomato in many parts of the world. The disease also occurs commonly in potatoes, eggplant, nightshade and occasionally on peppers of the family, *Solanaceae* (Stevenson 1993) [9]. Wherever tomatoes are grown in tropics without excess use of fungicides, the disease is commonly present (Griffith *et al.* 1995) [6]. The disease was reported having caused tomato and potato crops losses up to 100% (Fry 1999, Shrestha 199**7**, CIP 1999, Shrestha and Shrestha 1997, Pohronezny *et al.* 1986, Sherf and Macnab 1986) [5, 4, 8, 7, 10].
The tomato (*Lycopersicon esculentum* L.) is one of the most widely grown vegetable food crops in the world, second only to the potato. Crops of tomatoes have socioeconomic importance to families, gardeners, farmers, laborers, marketers, retailers, chefs and other workers and services in the food and restaurant industries India.
Tomatoes rank as the 10th most valuable agricultural commodity in the state. In addition, there are numerous unaccounted backyard or small tomato gardens in the state, making the tomato plant one of the most important and widely grown food crops.
Yet, a humid and tropical environment favors certain plant diseases. The fact that one lives in the subtropics where the climate allows year-round cultivation of tomatoes does not mean it is necessarily a good idea to do so, as many unsuspecting gardeners have learned. A destructive disease, late blight caused by *Phytophthora infestans*, awaits the tomato where it is cultivated in moist, cool, rainy, and humid environments.
This plant pathogen is one of the most notorious and devastating organisms in recent human history, being responsible for the terrible Irish potato (*Solanum tuberosum*) famine in the 1840s, and it is arguably the most important pathogen of potatoes and tomatoes worldwide.

Host
The tomato is a perennial plant in the Solanaceae, the nightshade family, with weak, woody, densely hairy stem that often vines over other plants. It reaches 3–10 ft in height (1–3 m) and bears clusters of edible fruits classified as vegetables.
Native to Central, South, and southern North America (Mexico to Peru), tomato is now grown in most arable locations of the world, either as an indoor or outdoor crop, hydroponically or in soil.

Pathogen

Phytophthora infestans (Mont.) de Bary is not a true fungus, but rather is regarded as a fungus-like organism. This pathogen is currently classified as an Oomycete, which are members of the kingdom Chromista (Stramenopiles or Straminopiles). Oomycetes belong to one of two orders, Saprolegniales and Peronosporales. The order Personosporales contains *Phytophthora* species and a number of other very important plant-pathogenic genera, including the genus *Pythium*. *P. infestans* has worldwide distribution, but most severe epidemics occur in areas with frequent cool, moist weather.

Winter weather patterns at these locations. Late blight is not as likely to occur in warmer, more arid regions of the state. The other important host for *P. infestans* is potato. The host range of *P. infestans* is mainly limited to solanaceous crops, including tomato, nightshade (*Solanum nigrum*), and potato. Sweetpotato (*Ipomea batatas*) is not a host for late blight.

Many strains of *P. infestans* have been reported in the India and worldwide. They vary genetically for virulence and have been able to overcome previously resistant plant varieties (e.g., potatoes), and they also pose the threat of developing resistance to certain types of fungicides. *P. infestans* infects all aboveground parts of susceptible plants at any stage of plant development.

Summary of the late blight disease cycle

Dissemination: Sporangia or mycelial fragments are dispersed from infected plant organs by winds and/or splashing raindrops or wind-driven rain. Inoculation: Sporangia or mycelial fragments land on susceptible host organ(s).

Infection and pathogen development: Sporangia germinate directly via germ tubes and penetrate a plant organ, or sporangia release motile zoospores which in turn encyst on host organs and penetrate the tissues via a penetration peg.

Symptom and disease development: Mycelium of the pathogen penetrates cell walls directly and ramifies inter Cellularly throughout host tissues, rapidly destroying them and leading to the development of the characteristic necrotic late blight symptoms. Sexual reproduction is rare in nature; more commonly, asexual reproduction occurs.

Disease symptoms and signs

On tomato leaves

Lesions begin as indefinite, water-soaked spots that enlarge rapidly into pale green to brownish-black lesions and can cover large areas of the leaf. During wet weather, lesions on the Abaxial surface of the leaf may be covered with a gray to white moldy. On the undersides of larger lesions, a ring of moldy growth of the pathogen is often visible during humid weather. As the disease progresses, the foliage turns yellow and then brown, curls, shrivels, and dies. The late blight symptoms are distinct from and should not be confused with symptoms of powdery mildew disease, the spores of which appear usually on the upper leaf surface of tomato (Scot C. Nelson. 2008) [12].

On tomato petioles and stems

Lesions begin as indefinite, water-soaked spots that enlarge rapidly into brown to black lesions that cover large areas of the petioles and stems. During wet weather, lesions may be covered with a gray to white moldy growth of the pathogen. Affected stems and petioles may eventually collapse at the point of infection, leading to death of all distal parts of the plant.

On tomato fruits

Dark, Olivaceuos greasy spots develop on green fruit; a thin layer of white mycelium may be present during wet weather.

Crop damage

This disease can spread rapidly during cool, rainy weather, killing plants within a few days and causing total crop loss. Effects on the plant include extensive defoliation, reduced photosynthetic leaf area, loss of plant vigor, plant death, loss of fruits and reproductive capacity, and loss of seeds.

Materials and Methods

Field experiments were conducted during the tomato growing seasons of 2014 and 2015 at the research farm of the Plant Pathology Division, College of Agriculture, Hanumanmatti, Ranebennur. The experiments were laid out in a Randomized black design with three replications and ten treatments. Each plot was 5 × 5m with, spaced 60 x 45 cm apart. The soil was red sandy loam fertilized with a basal dose of NPK at the rate of 45-60-60 kg/ha during land preparation. A second dose of nitrogen, 45 kg/ha N, was applied as a top dressing 30 days after transplanting.

Disease incidence

Observation on the extent of the foliage blighted was recorded and using the disease rating scale given by Mohan and Thind (1999) [11].

Table 1: Disease rating scales used in scoring observed diseases on Tomato plants.

Disease Score	Score description in terms of foliage infected (%)
0	No visible symptoms
1	1-10
2	11-25
3	26-50
4	51-75
5	>75

Further, these scales were converted into severity (Per cent disease index i.e. PDI) using the formula given by wheeler (1969) [13].

$$PDI = \frac{\text{Sum of numerical values}}{\text{Number of plant observed X Maximum disease rating value}} X\ 100$$

Phytotoxicity of test fungicides on Tomato

Phytotoxicity observation on 0-10 scale for leaf tips and surface injury, wilting, necrosis, epinasty and hyponasty.

Five plants were selected at random from each treatment and the total number of leaves and those showing phytotoxicity were counted. The data collected were converted in to percentage. The extent of phytotoxicity is recorded based on following score.

Table 2: Phytotoxicity rating scales on tomato plants

Scale	
Percentage	**Grade**
0-10%	1
11-20%	2
21-30%	3
31-40%	4
41-50%	5
51-60%	6
61-70%	7
71-80%	8
81-90%	9
91-100%	10

Results and Discussion

The result presented in Table-2 revealed that, all the fungicidal treatments were found effective in reducing the per cent disease index (PDI) of Late blight of Tomato over control. Least PDI was observed in the treatment, Mancozeb 75% WP @1000g / 500L of water/ha. Of three time sprays followed by bio fungicide NZBBA1106@ 370g/500L of water/ha (PDI 20.25%). The next most effective chemical was Mancozeb 75% WP@1000g/ 500L of water/ha foreight times spray. (PDI 20.85%). Among the bio- fungicides tested, the treatment-NZBBA1106 @500g/500L of water/hawas found effective (PDI 21.80%). The highest late blight disease severity was recorded in untreated control (PDI-50.25%).

Overall the bio-fungicide treatment, NZBBA1106 @ 500g/ 500L of water/hawas found most effective treatment by showing 56.62% reduction in disease severity over control followed by NZBBA1106 @ 370g/ 500L of water/ha (53.83%).

Yield

The maximum yield was recorded in the treatment T9 (Macozeb75%WP@ 1000g/500L of water /ha. followed by Bio- fungicide NZBBA1106) [21.40t/ha]. The next best was T1 (Mancozeb alone @ 1000g/500L of water /ha T1 (20.69t/ha). Among bio-fungicides tested, the treatmentT5 (NZBBA1106 @ 500g/ 500L of water/ha) recorded best with 20.20t/ha. The least yield was recorded in T10 (untreated control) [15.85t/ha]

Table 3: Effect of TAEGRO bio-agent against *Phytophthora* late blight in Tomato

Sl. No	Treatments	Concentration	Percent severity/PDI (%)	Per cent (%) severity reduction	Yield/ Ton /ha
T_1	Mancozeb 75 WP	1000g/500 ltr/ha 8X	20.85 (27.17)*	58.51	20.69
T_2	Local *Bacillus*	2500g/500ltr /ha 8X	26.47 (30.96)	47.32	18.39
T_3	NZ BBA 1106	185 g/ 500ltr/ha 8X	24.35 (29.56)	51.54	19.30
T_4	NZ BBA 1106	370 g/500ltr /ha 8X	23.20 (28.79)	53.83	19.75
T_5	NZ BBA 1106	500g/500ltr ha 8X	21.80 (27.83)	56.62	20.20
T_6	Mancozeb 75WP	1000g/500 ltr /ha5X	22.55 (28.35)	55.12	19.90
T_7	NZ BBA 1106	370g /500ltr/ ha 3X	24.40 (29.60)	51.44	19.20
T_8	Mancozeb 75 WP	1000g/500 ltr 3X	23.60 (29.06)	53.03	19.50
T_9	Mancozeb 75 WP followed byNZ BBA 1106	1000g/500 ltr 370 g/500ltr/ha 5x	20.25 (26.74)	59.70	21.40
T_{10}	Control	-	50.25 (45.14)	-	15.85
	SEm±		0.98	-	0.73
	CD (0.05)		2.92	-	2.17

*Figures in parenthesis indicate arcsine values.

Phytotoxicity

The result of phytotoxicity studies of bio-fungicides NZBBA1106 is presented in Table-3. There were no visual symptoms of phytotoxicity in terms of leaf tips and surface injury, wilting, necrosis, epinasty and hyponasty were noticed on Tomato crop in all the treatment.

Table 4: Phytotoxicity report

Day of observation after spray	Sl.No.	Treatments	Phytotoxicity Symptoms				
			Leaf tips and surface injury	Wilting	Vein clearing	Necrosis	Epinasty and hyponasty
1st Day	1.	Untreated control	0	0	0	0	0
	3.	Recommended dose –	0	0	0	0	0
	5.	X	0	0	0	0	0
	7	2X	0	0	0	0	0
	10.	4X	0	0	0	0	0
3rd Day	1.	Untreated control	0	0	0	0	0
	3.	Recommended dose –	0	0	0	0	0
	5.	X	0	0	0	0	0
	7	2X	0	0	0	0	0
	10.	4X	0	0	0	0	0
5th Day	1.	Untreated control	0	0	0	0	0
	3.	Recommended dose –	0	0	0	0	0
	5.	X	0	0	0	0	0
	7	2X	0	0	0	0	0
	10.	4X	0	0	0	0	0
7th Day	1.	Untreated control	0	0	0	0	0
	3.	Recommended dose –	0	0	0	0	0
	5.	X	0	0	0	0	0
	7	2X	0	0	0	0	0

	10.	4X	0	0	0	0	0
10^{th} Day	1.	Untreated control	0	0	0	0	0
	3.	Recommended dose –	0	0	0	0	0
	5.	X	0	0	0	0	0
	7	2X	0	0	0	0	0
	10.	4X	0	0	0	0	0

Score: 0= No Phytotoxicity 100=100% Phytotoxicity

Conclusion

The application of Bio-fungicides NZBBA1106 significantly decreases the Late blight disease in tomato. Though, all doses of bio-fungicides NZBBA1106 tested were found effective, NZBBA1106 @500g/500L/ha can be recommended for the management of late blight of Tomato disease with non-phytotoxic effect.

References

1. Arti Bairwa A, Venkatasalam EP, Sudha R, Umamaheswari R, Sanjeev Sharma, Singh BP. Management of late blight disease in Kharif Potato at Karnataka. Potato J. 2016; 43(2):173-181.
2. Satish Kumar BS. Blight spread due to lack of biosecurity system. The Hindu, November, 2013, 16.
3. Chowdappa P, Girija Ganeshan, Ramachandran N. Control of late blight disease in tomato. The Hindu, February, 2009, 12.
4. CIP. Integrated control of late blight. International Potato Center (CIP), 1999. http://cipotato.org/blight/lblight.htm.
5. Fry WE. Potatoes, once again under fungal Attack, 1999,http://ars.usda.gov/s/pr/potato0597.htm.
6. Griffith GW, Snell R, Shaw DS. Late blight (*Phytophthora infestans*) on tomato in the tropics. Mycologist.1995; 9:87-89.
7. Pohronezny K, Wadill VH, Schuster DJ, Sonoda RM. Integrated pest management for Florida tomatoes. Plant Dis. 1986; 70:96-103.
8. Shrestha SK, Shrestha K. An epidemics of late blight of tomato. Nepalese J of Agriculture. 1997; 18-29:141-144.
9. Stevenson WR. Management of early blight and late blight. Plant Health Management Series (RC Rowe, Ed). The American Phytopathological Society, 1993.
10. Sherf AF, Macnab AA. Vegetable diseases and their control. A Wiley Inter Science Publication, John Wiley and Sons, New York, 1986.
11. Mohan C, Thind TS. Resistance and relative performance of some new fungicides for active management of potato late blight in Punjab. Indian. J Mycol. Plant Pathol. 1999; 29(1):23-37. <http://www.ctahr.hawaii.edu/freepubs>.
12. Scot Nelson C. Late Blight of Tomato (*Phytophthora infestans*). Department of Plant and Environmental Protection Sciences, Corporative extension service, College of Tropical Agriculture and Human Resources, University of Hawai'I at Manoa, Plant Disease PD 45, 2008.
13. Wheeler BEJ. An introduction to plant diseases. John Wiley and Sons Ltd., London, 1969.