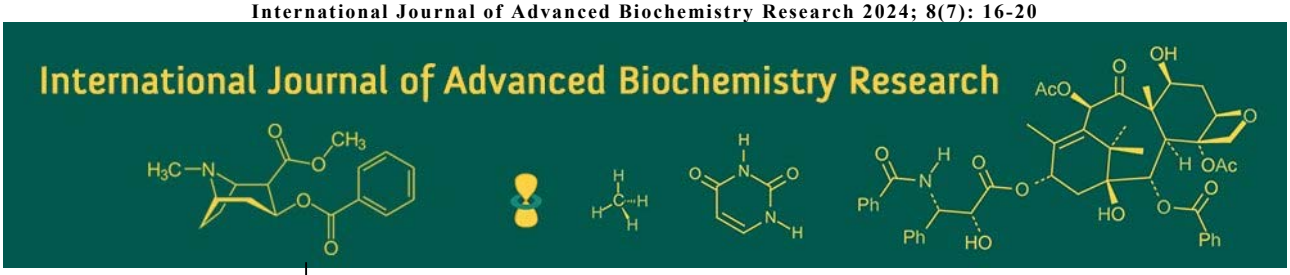

ISSN Print: 2617-4693
ISSN Online: 2617-4707
IJABR 2024; 8(7): 16-20
www.biochemjournal.com
Received: 15-04-2024
Accepted: 19-05-2024

Shinde TB
Agricultural Microbiologist, Bharti Green Tech, A/P Sokasan, Tal. Man, Satara, Maharashtra, India

Borate VA
Supervisor, Bharti Green Tech, A/P Sokasan, Tal. Man, Satara, Maharashtra, India

Chavan SD
Managing Director, Bharti Green Tech, A/P Sokasan, Tal. Man, Satara, Maharashtra, India

Pol VB
Managing Director, Bharti Green Tech, A/P Sokasan, Tal. Man, Satara, Maharashtra, India

Corresponding Author:
Shinde TB
Agricultural Microbiologist, Bharti Green Tech, A/P Sokasan, Tal. Man, Satara, Maharashtra, India

In-vitro compatibility of *Penicillium pinophilum* with commonly used fungicides, insecticides herbicides and fertilizers in different crops

Shinde TB, Borate VA, Chavan SD and Pol VB

DOI: https://doi.org/10.33545/26174693.2024.v8.i7a.1426

Abstract
An *in-vitro* compatibility studies were conducted with *Penicillium pinophilum* and some commonly used, commercially available chemical pesticides and fertilizers in sugarcane. The experiment was laid out in a Completely Randomized Design (CRD) with three replications and thirteen treatments. In this study, three treatments of fungicides [Carbendazim 50% WP (Bavistin), Mancozeb 63% WP + Carbendazim 12% WP (SAAF), Thiophenate methyl 70% WP (Roko)], three treatments of insecticides [Thiamethoxam 30% FS (Slayer pro), Chlorpyriphos 50% + Cypermethrin 5% EC (Hamla), Azoxystrobin 2.5% + Thiophenate methyl 11.25% + Thiomethoxam 25% FS (Electron)], three treatments of herbicides [Atrazine 50% WP (Atrataf), Ametryne 80% WDG (Tamar), 2, 4-D sodium salt 44% + Metribuzin 35% + Pyrazosulfuron-ethyl 1.0% WG (Triskele)], three treatments of fertilizers (Urea, Di-ammonium phosphate, Muriate of potash) and *P. pinophilum* culture grown on PDA served as a control. Among fungicides, Carbendazim and Thiophenate methyl were found to be compatible, whereas Mancozeb + Carbendazim was found to be toxic. The insecticides Thiomethoxam and Azoxystrobin + Thiophenate methyl + Thiomethoxam were compatible, while Chlorpyriphos + Cypermethrin proved incompatible. The herbicides, Ametryne and 2, 4-D sodium salt + Metribuzin + Pyrazosulfuron were incompatible and Atrazine was found to be slightly toxic. Among fertilizers, Urea and Di-ammonium phosphate were found to be compatible and Muriate of potash showed additional colony growth over control.

Keywords: Compatibility, *Penicillium pinophilum*, fungicides

Introduction
Control of plant diseases and pests by chemicals can be spectacular but this is relatively short term measure and moreover, the accumulation of harmful chemical residues sometimes causes serious ecological problems. In agriculture, biocontrol agents are a safe and environmentally acceptable alternative to pesticides (Gampala and Pinnamaneni, 2010) [5]. Recommended doses of insecticides along with biocontrol agents show promising effects on the management of various plant pests than the chemicals alone (Vinit *et al*., 2012) [17]. Combining a fungicide tolerant biocontrol agent with respective fungicides has improved the extent of disease control and reduced the quantity of fungicides required for effective management (Buck, 2004) [3]. Therefore the combine use of biocontrol agents and chemical pesticides has enticed much attention as a way to obtain synergistic or additive effects in the control of soil borne pathogens (Locke *et al*., 1985) [8]. The herbicides, insecticides and fungicides applied as foliar spray or soil drench ultimately reach the soil and affect beneficial non-target mycoflora. Hence, knowledge of compatibility of all these biocontrol agents with important pesticides may help opt for better plant protection measures. Tolerance to commonly-used pesticides enhances the efficacy and expands the scope of application of biocontrol agent. Phosphorous and potassium is important nutrients for growth and yield of sugarcane. Fungus, *P. pinophilum* has been found to have tremendous potential for making the naturally unavailable potassium and phosphorus in the soil into easily available form for the plant (Maity *et al.* 2014) [10]. Hence, an *in vitro* study was conducted to assess the compatibility of some commonly used, commercially available fungicides, insecticides, herbicides and fertilizers with the growth of *P. pinophilum*.

Materials and Methods

The present study of testing the compatibility of *P. pinophilum* with pesticides was conducted at the Microbiology Laboratory at Bharti green tech. Dahiwadi, during the year 2023, using the poisoned food technique (Nene and Thapliyal, 1993) [13], Potato Dextrose Agar medium (PDA) and three replications in CRD. All nine chemical pesticides were used according to the recommended application rate for field crops and fertilizers were used at 1 percent.

Estimation of fungal colony growth

Observations of the mycelial growth of biocontrol agents were recorded by measuring the diameter (mm) of radial growth by using the measuring scale. Observations of four replications are recorded every 72 hours, till 144 hours are completed. The growth inhibition of biocontrol agents was estimated by using the following formula given by Vincent (1947) [16] and percent inhibition of mycelial growth was obtained.

$$I = \frac{C - T}{C} \times 100$$

Where,
I = Percent growth inhibition.
C = Colony diameter in control (mm).
T = Colony diameter in treatment (mm).
On the basis of the results at 144 hrs, the pesticides were classified into 4 categories based on percent growth inhibition (Ambethgar, 2009) [1] as below.

Category	Percent growth inhibition	Toxicity level
1	>50	Toxic
2	35 – 49.9	Moderately Toxic
3	25 – 34.9	Slightly Toxic
4	< 25	Compatible

Table 1: Chemical pesticides and their concentrations

Treatment No.	Trade name	Content	Dose per 100 ml media
Fungicides			
T_1	Bavistin	Carbendazim 50% WP	0.2 gm
T_2	SAAF	Mancozeb 63% WP + Carbendazim 12% WP	0.2 gm
T_3	Roko	Thiophenate methyl 70% WP	0.05 gm
Insecticides			
T_4	Slayer pro	Thiamethoxam 30% FS	0.05 gm
T_5	Hamla	Chlorpyriphos 50% + Cypermethrin 5% EC	0.2 ml
T_6	Electron	Azoxystrobin 2.5% + Thiophenate methyl 11.25% + Thiomethoxam 25% FS	
Herbicides			
T_7	Atrataf	Atrazine 50% WP	0.2 gm
T_8	Tamar	Ametryne 80% WDG	0.5 gm
T_9	Treskele	2, 4-D sodium salt 44% + Metribuzin 35% + Pyrazosulfuron-ethyl 1.0% WG	0.6 gm
Fertilizers			
T_{10}	Urea	46:00:00	1 gm
T_{11}	Di-ammonium phosphate	18:46:00	1 gm
T_{12}	Muriate of potash	00:00:60	1 gm
T_{13}	Control	-	-

Results and Discussion

1. Effect of fungicides on *P. pinophilum.*

Among the fungicides (Table 2), Carbendazim and Thiophenate methyl inhibited growth by 6 and 9 percent at 144 hrs, respectively, and were found to be compatible. Hence, it gives chances to use where this *P. pinophilum* is applied. However, *P. pinophilum* was completely incompatible with the fungicide Mancozeb + Carbendazim, which showed 100 percent colony growth inhibition.
Khalil *et al.* (1985) [7] discovered that the fungicides Thiophenate methyl and Mancozeb were partially incompatible with the fungus *Verticillium lecanii*. Mohamad and Radwan (2017) [12] discovered that Mancozeb was incompatible with *T. harzianum*. Maheshwary *et al.* (2020) [9] discovered that the fungicide Mancozeb + Carbendazim was incompatible with the fungus *Trichoderma asperellum*.

2. Effect of insecticides on *P. pinophilum.*

In the case of insecticides (Table 2), only Chlorpyriphos + Cypermethrin was found to be incompatible, which showed 56 percent inhibition, while Azoxystrobin + Thiophenate methyl + Thiomethoxam was found to be slightly toxic. Thiomethoxam showed 1 percent growth inhibition and found to be totally compatible.
Similar results were found by Oliveira *et al.* (2003) [14] insecticide, Thiomethoxam was found to be compatible and Chlorpyriphos was found totally incompatible with the fungus *B. bassiana*. Martinez Toledo *et al.* (1998) [11] and Desai and Kulkarni (2004) [4] also reported that strong inhibition of *Trichoderma harzianum* by Chlorpyriphos in addition to methyl Prymifos.

3. Effect of herbicides on *P. pinophilum.*

Except Atrazine (Table 2), the remaining two herbicides were incompatible with *P. pinophilum*. Herbicides Ametryne and 2, 4-D sodium salt + Metribuzin + Pyrazosulfuron-ethyl showed 88 and 76 percent inhibition and were found toxic to *P. pinophilum.* Atrazine showed 29 percent inhibition and was found to be slightly toxic.
Desai and Kulkarni (2004) [4] observed similar results, reporting that Atrazine was a comparably safer pesticide when used with *Trichoderma harzianum*. Gardner and Storey (1985) [6] found that the herbicide 2, 4-D substantially reduced both germination and development of *B. bassiana* at 6 mg (AI)/ml.

4. Effect of fertilizers on *P. pinophilum*: Among the fertilizers (Table 2), Urea, Di-ammonium phosphate and

Muriate of potash proved totally compatible with *P. pinophilum*, which showed 20, 6 and -5 percent colony growth inhibition, respectively. Muriate of potash showed more colony growth of *P. pinophilum* than control.
Similar results were observed by Bhai and Thomas (2010) [2] Fertilizers showed compatible with *T. harzianum*. In addition they were found to be favourable in increasing the *T. harzianum* population. Gampala and Pinnamaneni (2010) [5] stated that Muriate of Potash and Super Phosphate showed greater compatibility than Urea.

Table 2: Colony growth inhibition

Treatments	Average colony diameter of *P. pinophilum* (mm)				Toxicity level
	72 hrs	% inhibition	144 hrs	% inhibition	
Fungicides					
T_1 Carbendazim 50% WP (Bavistin)	2.88	33	26.22	6	Compatible
T_2 Mancozeb 63% WP + Carbendazim 12% WP (SAAF)	0.00	100	0.00	100	Toxic
T_3 Thiophenate methyl 70% WP (Roko)	3.78	13	25.33	9	Compatible
Insecticides					
T_4 Thiamethoxam 30% FS (Slayer pro)	3.11	28	27.52	1	Compatible
T_5 Chlorpyriphos 50% + Cypermethrin 5% EC (Hamla)	0.11	97	12.22	56	Toxic
T_6 Azoxystrobin 2.5% + Thiophenate methyl 11.25% + Thiomethoxam 25% FS (Electron)	3.66	15	19.12	31	Slighly toxic
Herbicides					
T_7 Atrazine 50% WP (Atrataf)	2.66	39	19.77	29	Slighly toxic
T_8 Ametryne 80% WDG (Tamar)	0.00	100	3.44	88	Toxic
T_9 2, 4-D sodium salt 44% + Metribuzin 35% + Pyrazosulfuron-ethyl 1.0% WG (Triskele)	0.00	100	6.77	76	Toxic
Fertilizers					
T_{10} Urea	2.43	43.87	22.20	20	Compatible
T_{11} Di-ammonium phosphate	2.55	41	26.11	6	Compatible
T_{12} Muriate of potash	3.66	15	29.22	-5	Compatible
T_{13} Control	4.33	-	27.89		
SE (m)	0.53		0.96		
CD at 1%	1.55		2.86		

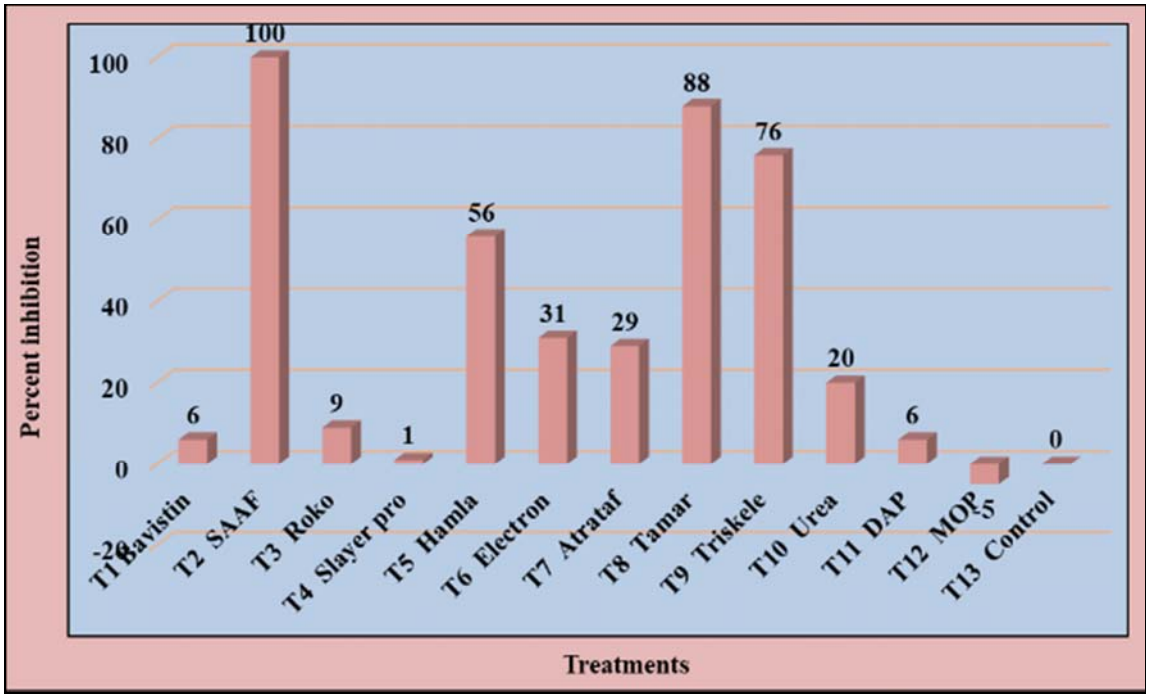

Fig 1: Inhibition percentage of colony growth of *P. pinophilum* by different pesticides and fertilizers.

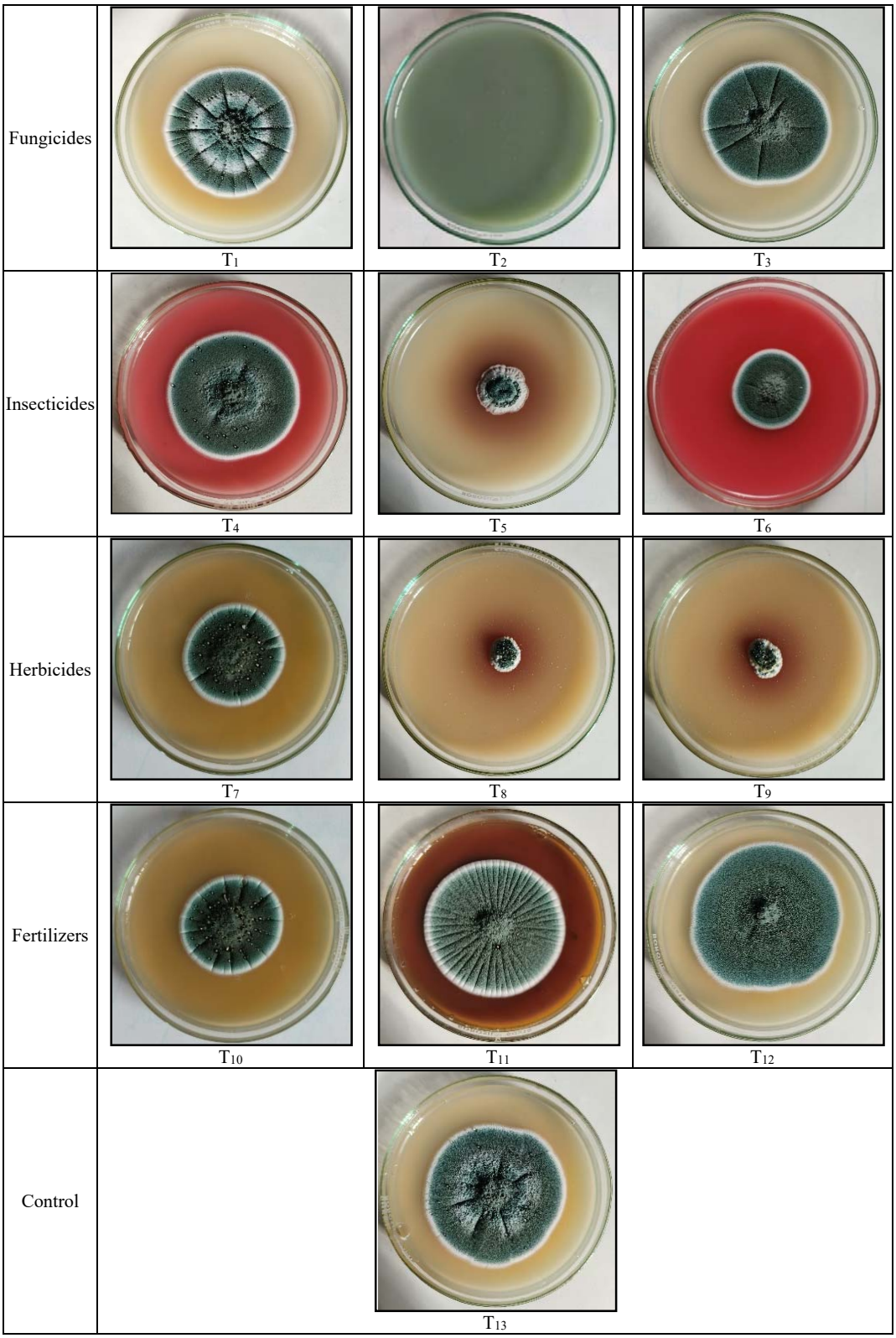

Fig 2: Colony growth of *P. pinophilum.*

Conclusion

- Carbendazim and Thiophenate methyl were found to be compatible; hence, it can be used in the sugarcane where *P. pinophilum* has already been applied for nutrient management.
- The insecticides Thiomethoxam and Azoxystrobin + Thiophenate methyl + Thiomethoxam were compatible; hence, combined use of all these insecticides will be safer for *P. pinophilum*.
- The herbicide Atrazine was found to be slightly toxic, so it can be applied safely in the IPM system. The herbicides Ametryne and 2, 4-D sodium salt + Metribuzin + Pyrazosulfuron were incompatible, so

application of both must be avoided in *P. pinophilum*-applied soils.

- Among fertilizers, Urea and Di-ammonium phosphate were found compatible and Muriate of potash showed additional colony growth over control.
- Some chemical pesticides and fertilizers do not affect the growth and development of *P. pinophilum*. The combination of such chemical pesticides can provide an additive or synergistic effect in the nutrition and control of diseases and pests in sugarcane.

References

1. Ambethgar V, Swamiappan M, Rabindra RJ, Rabindran R. Influence of some herbicides on *in vitro* vegetative growth of *Beauveria bassiana* (Balsamo) Vuillemin. Resistant Pest Management Newsletter. 2009;19(1):11-14.
2. Bhai SR, Thomas J. Compatibility of *Trichoderma harzianum* (Rifai.) with fungicides, insecticides and fertilizers. Indian Phytopathology. 2010;63(2):145-148.
3. Buck JW. Combination of fungicides with phylloplane yeasts of improved control of Botrytis cinerea on geranium seedlings. Phytopathology. 2004;94:196-202.
4. Desai SA, Kulkarni S. Effect of fungicides, insecticides and weedicides on the growth and sporulation of native *Trichoderma harzianum* Rifai. Karnataka Journal of Agricultural Sciences. 2004;17(1):57-62.
5. Gampala K, Pinnamaneni R. Studies on the compatibility of Trichoderma viride with certain agro-chemicals. Current World Environment. 2010;5(1):155-158.
6. Gardner WA, Storey GK. Sensitivity of Beauveria bassiana to selected herbicides. Journal of Economic Entomology. 1985;78:1275-1279.
7. Khalil SK, Shah MA, Naeem M. Laboratory studies on the compatibility of the entomopathogenic fungus *Verticillium lecanii* with certain pesticides. Agriculture, Ecosystems & Environment. 1985;13:329-334.
8. Locke JC, Marois JJ, Papavizas GC. Biological control of Fusarium wilt of greenhouse grown Chrysanthemum. Plant Disease. 1985;69:167-169.
9. Maheshwary NP, Gangadhara NB, Amoghvarsha C, Naik MK, Satish KM, Nandish MS. Compatibility of *Trichoderma asperellum* with fungicides. The Pharma Innovation Journal. 2020;9(8):136-140.
10. Maity A, Singh NV, Pal RK. Penicillium pinophilum - A novel microorganism for nutrient management in pomegranate (*Punica granatum* L.). Scientia Horticulturae. 2014;169:111-117.
11. Martinez-Toledo MV, Salermon V, Rodelas B, Pozo C, Gonzalez-Lopez J. Effects of the fungicide captan on some functional groups of soil microflora. Applied Soil Ecology. 1998;7:245-255.
12. Mohamed NA, Radwan MA. Impact of pesticides on Trichoderma harzianum and on its possible antagonistic activity against Fusarium oxysporum under *in vitro* conditions. Asian Journal of Agriculture & Biology. 2017;5(4):291-302.
13. Nene YL, Thapliyal PN. Fungicides in plant disease control. New Delhi: Oxford and IBH; c1993.
14. Oliveria GN, Neves PMOJ, Kawazoe LS. Compatibility between the entomopathogenic fungus Beauveria bassiana and insecticides used in coffee plantations. Scientia Agricola. 2003;60(4):663-667.
15. Radwan MA, Mohamed NA. Impact of pesticides on Trichoderma harzianum and on its possible antagonistic activity against Fusarium oxysporum under *in vitro* conditions. Asian Journal of Agriculture & Biology. 2017;5(4):291-302.
16. Vincent JM. The esters of 4-hydroxybenzoic acid and related compounds. Part I. Methods for the study of their fungistatic properties. Journal of the Society of Chemical Industry. 1947;66(5):149-155.
17. Vinit PS, Seweta S, Swapnil KS, Sing HB. Compatibility of different insecticides with T. harzianum under *in vitro* condition. Plant Pathology Journal. 2012;11(2):73-76.