



ANTIFUNGAL ACTIVITY OF POTASSIUM PHOSPHITE AGAINST DOWNY MILDEW CAUSING *PLASMOPARA VITICOLA* IN GRAPE

Kailas Bhise^a, Abhijeet Bhise^a, Hrishikesh Vitekari^{a*}, Kalyani Mhetar^a, Ravindra Mane^b

^a Skylite Agrochem Company, Sangli, Maharashtra, India

^b S P College of Agriculture, Chiplun, Maharashtra, India

*Corresponding Author Email: skyliteagro@gmail.com

ABSTRACT

Grape cultivation in many part of India has been severely affected by Downy mildew caused by *Plasmopara viticola*. In the present study Potassium Phosphite was evaluated for antifungal activity against *Plasmopara viticola* in vitro. Different concentrations of Potassium Phosphite were prepared separately and checked against pathogen for 24 hours. Among these concentrations Potassium Phosphite at 4000 ppm showed maximum zone of inhibition of 10 mm whereas concentrations of 1000 ppm exhibited least zone of inhibition. All the concentrations show inhibitory effect on growth of *Plasmopara viticola*. This study would be highly useful to control the downy mildew of grape with the compatibility of Potassium Phosphite with other compounds.

KEY WORDS

Downy mildew, Grape, *Plasmopara viticola*, Potassium Phosphite

INTRODUCTION

Grapevine and Downy mildew

Grapevine (*Vitis vinifera*) is economically the most important fruit species globally because of the numerous uses of its fruit in the production of wine, juice, table grapes, dried fruit and organic compounds. Fungal pathogens are a major problem affecting grapevine yield either by a direct infection of berries or by a reduction of plant vigor [1, 2]. Among the fungal diseases affecting grapes in India, downy mildew caused by *Plasmopara viticola* is considered the main disease for this crop. Downy mildew caused by an oomycete, *Plasmopara viticola*, is one of the most destructive diseases in vineyards. This disease is associated to significant losses caused by total or partial destruction of inflorescences, fruits, and by the premature fall of the leaves [3]. Symptoms will vary depending on the age of leaf tissue. Newly developed leaves that are infected by *P. viticola* will often develop yellow lesions that are oily in appearance. More mature tissues will have an angular lesion that is yellow to reddish-brown and limited by leaf veins. On the lower leaf surface, the cottony growth

(mycelium) of *P. viticola* will often be readily apparent. Now day's disease control is generally achieved by the use of fungicides. However, fungicide-resistant strains of the pathogen have developed, rendering some fungicides ineffective [4, 5].

Potassium Phosphite

Potassium Phosphite is widely used in the management of fungal diseases in agriculture, horticulture and natural environments [6]. Phosphite works by boosting the plant's own natural defenses [7, 8, 9, 10]. Phosphite is not toxic to people or animals and its toxicity has been compared to table salt. Potassium phosphite is an agent that has a systemic effect against fungal diseases, in particular against downy mildew [11]. Potassium phosphite has also been widely used in agriculture for the many advantages that it offers, especially to increase phosphorus uptake by the plant compared to products based on traditional phosphate [12, 13, 14].

Aim and Objective

To isolate pathogenic microorganism from affected leaf sample and to screen antifungal/antioomycete activity

of Potassium Phosphite against microorganisms causing downy mildew of grape.

MATERIAL AND METHODS

Isolation and identification of pathogens

Grape vine leaf samples (variety) infected with downy mildew were collected from city-Miraj, Maharashtra and identified by the S P College of Agriculture, Chiplun, Maharashtra, India. The infected leaf was washed three times with distilled water. The infected leaf was transferred in sterilized petriplates containing solidified 1% agar medium by leaf transfer method. Later the petriplate was incubated at 30 ° C for 24 hrs [15]. After incubation period the leaf was removed gently.

Preparation of Potassium Phosphite Solution

Potassium Phosphite powder was mixed in distilled water to get various concentrations- 1000 ppm, 2000 ppm, 3000 ppm and 4000 ppm. (1000 ppm = 1gm Potassium Phosphite/Liter of water)

Antifungal Activity

The antifungal activity of Potassium Phosphite was determined by agar well diffusion method [16]. A sterile 5 mm borer was used to cut 4 wells at equidistance in the plate. 80 µl of the test compound was introduced into each well and allowed to diffuse properly by keeping the petri plates in refrigerator at 4°C for 2 hours followed by incubation at 37°C for 24 hours. The diameter of zone of inhibition (excluding well diameter) was taken as the measure of the antimicrobial activity of a particular extract.

RESULTS

After incubation of the plates for 24 hrs at 30 ° C results were observed and noted. It was observed that at concentration of 4000 ppm, the Potassium Phosphite exhibited significant antimicrobial activity against *Plasmopara viticola* (Figure 3). From Table 1, it is observed that Potassium Phosphite showed zone of inhibition at all concentrations. It showed minimum activity at 1000 ppm. There was stationary phase of activity at concentration 2000 and 3000 ppm.

Sr. No	Concentration of Potassium Phosphite (ppm)	Zone of Inhibition (mm)
1	1000	7
2	2000	8
3	3000	8
4	4000	10

Table No 1: Potassium Phosphite Activity

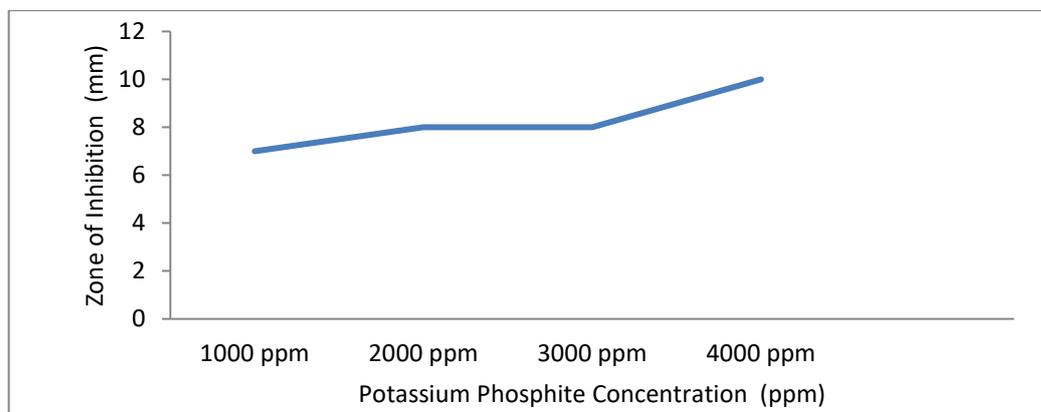


Figure 1: Graphical Analysis of Pot Phosphite conc. Vs Zone of Inhibition



Figure 2: Downy mildew of grape

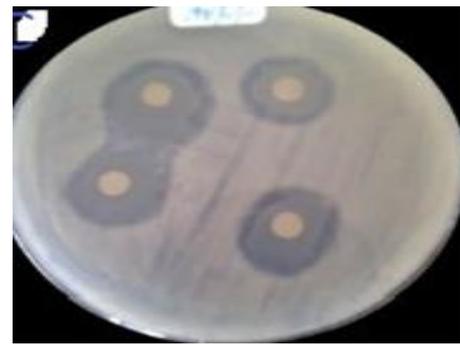


Figure 3: Potassium Phosphite Activity Against *Plasmopara viticola*

DISCUSSION

In this study, we found that Potassium phosphite controlled downy mildew caused by *P. viticola* in grape leaf. Phosphites are found to be much better than traditional phosphates. It works systemically against oomycetes. Several recent laboratory studies show that application of phosphite compounds improves plant defense. Downy mildew caused by *Plasmopara viticola*, is one of the most destructive diseases in vineyards. Protection against it involves several applications of fungicides. These pesticides have a harmful impact on the environment as well as on human health. Major issue associated with these control measure is the decrease in plant immunity against further attack and other pathogens. Thus, developing alternative strategies such as the use of residue free chemicals, natural products from plants that are biodegradable and usually less toxic has become a pressing need. Potassium phosphite has significantly improved the agricultural acceptability. Compatibility of Potassium phosphite with contact fungicides and many other secondary metabolites will be a new area of research.

CONCLUSION

Potassium phosphite exhibited anti-fungal activity against *Plasmopara viticola* causing downy mildew in grape. Further study is necessary to understand intracellular action of Potassium Phosphite at molecular level.

ACKNOWLEDGMENT

Authors are thankful to Western Bio Organics Company, Sangli, Maharashtra for their kind support for this research.

REFERENCES

- [1] R.M.Pool, R.C. Welser , A.N. Lakso and R.C.Seem , "Influence of powdery mildew on Yield and growth of rosette grapevines". Plant Disease 68, 590-593, 1984.
- [2] D.M. Gadoury , R.C.Seem, R.C.Pearson, W.F.Wilcox and R.M. Dunst, "Effects of powdery mildew on vine growth, yield, and quality of concord grapes". Plant Disease 85, 137-140, 2001.
- [3] O.R.Sonego, L.R.Garrido, J.Grigoletti, "A.Principais doenças fúngicas da videira no sul do Brasil". Bento Gonçalves: Embrapa Uva e Vinho,. 32p.Circular Técnica, 56, 2005.
- [4] P. LeRoux and M. Clerjeau, "Resistance of *Botrytis cinerea* Pers. and *Plasmopara viticola* (Berk. & Curt.) Berl. and de Toni to fungicides in the French vineyards". Crop Prot. 4:137-160, 1985.
- [5] R.C. Pearson and A.C.Goheen , "Compendium of Grape Diseases".The American Phytopathological Society, St. Paul, MN. 1988.
- [6] R.Daniel , B.A.Wilson and D.M. Cahill, "Potassium phosphonate alters the defence response of *Xanthorrhoea australis* following infection by *Phytophthora cinnamomi*". Vol34, Issue 4,541-548, 2005.
- [7] D.Burra, O.Berkowitz, P.E.Hedley, J.Morris, S. Resj€o, F.Levander, E. Liljeroth, E.Andreasson and E. Alexandersson , "Phosphite-induced changes of the transcriptome and secretome in *Solanum tuberosum* leading to resistance against *Phytophthora infestans*". BMC Plant Biol. 14, 254, 2014.
- [8] L.Eshraghi , J.Anderson , N. Aryamanesh , B. Shearer, J. McComb, G.E.S.Hardy, P.A. O'Brien, "Phosphite primed defence responses and enhanced expression of defence genes in *Arabidopsis thaliana* infected with *Phytophthora cinnamomi*". Plant Pathol. 60, 1086e1095, 2011.
- [9] S.Lim, T. Borza, R.D. Peters, R.H.Coffin, K.I. Al-Mughrabi, D.M. Pinto, G.Wang- Pruski, "Proteomics analysis suggests broad functional changes in potato leaves triggered by phosphites and a complex indirect mode

- of action against *Phytophthora infestans*." J. Proteomics 93, 207e223, 2013.
- [10] K. Massoud, T. Barchietto, T. Le Rudulier, L. Pallandre, L. Didierlaurent, M. Garmier, F. Ambard-Bretteville, J.M.Seng, P. Saindrenan, "Dissecting phosphite-induced priming in *Arabidopsis* infected with *Hyaloperonospora arabidopsidis*". Plant Physiol. 159, 286e298, 2012.
- [11] V.F.Pereira, M.L.V.Resende, A.C.A.Monteiro, P.M.Ribeiro Junior, M.A.Regina, F.C.I.Medeiros, "Produtos alternativos na proteção da videira contra o míldio". Pesquisa, Agropecuária Brasileira, Brasília, v. 45, n. 1, p. 25-31, 2010.
- [12] M.D.Cohen, M.D.Coffey, "Systemic fungicides and the control of Oomycetes". Annual Review of Phytopatology 24:311-338, 1986.
- [13] T.J.Jackson, "Action of the fungicide phosphite on *Eucalyptus marginata* inoculated with *Phytophthora cinnamomi*". Plant Pathology 49:147-154, 2000.
- [14] K.Bhise, A. Bhise, H. Vitekari, 'Potassium Phosphite As A Potent Fungicide: Review', International Journal of Agriculture.127 (431-435). 2016.
- [15] S.T.Yenjerappa, "Epidemiology and management of bacterial blight of pomegranate caused by *Xanthomonas axonopodis* pv. *Punicae*" (Hingorani and Singh) vauterin *et al.* Th9936 (accession no) submitted to University of Agricultural Sciences, Dharwad.Karnataka State, India. 2009.
- [16] C.Perez, M. Paul and P. Bazerque, "An antibiotic assay by the agar well diffusion method", *Acta Biol. Med. Exp.*, 15, 113-115. 1990.

***Corresponding Author:**

Hrishikesh Vitekari*

Email: skyliteagro@gmail.com