RESEARCH ARTICLE

Effect of *Trichoderma Spp.* as a Bio-control Agent on Cereal Crop Plants

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ABSTRACT

*Trichoderma* is a Deuteromycetous fungus with hyphae long, creeping, conidiophores erect, philiadic, having conidial heads. *Trichoderma* species produces a chemical, trichodermin; it is the sesquiteroenoid acting as a bio-control agent on the principal of myco-parasitism, antibiosis and competition to control soil borne plant pathogens. The phytotoxic effect was screened by treating cereal crop seeds with culture filtrate of *Trichoderma* species, the effect of culture filtrate was measured in terms of seed germination percentage and results were compared with control one. The obtained results shows percentage of germination in treated seeds was more than the control. The culture filtrate of *Trichoderma harzianum* showed superior effects (95-97%) than that of *Trichoderma viridae* (90-95%) and *Trichoderma virens* (86-92%) on the seed germination of selected cereal crop seeds.

Keywords: Culture filtrates, Trichoderma, Cereal crop seeds.
INTRODUCTION

In advanced technology of agriculture, use of *Trichoderma* species as bio-control agents for the management of crop plant diseases, now it becomes a modern trend. Apart from enzymes, the species of *Trichoderma* are also producers of various metabolites with toxic antibiotic properties (Bruckner *et al.*, 1990, Dennis and Webster, 1971, Stepanovic and Howell, 1982., Tomoda *et al.*1992., Huang *et al.* 1995). Number of secondary metabolites are produced by their metabolic pathways. (Sivasitharamparam and Ghisalberti, 2002). They are frequently associated with both biocontrol activity and promotion of plant and root growth. (Chet *et al.*,2006, Howell, 1998). Aspite *et al.* (1996) extracted trichodermin from *Trichoderma viridae* and *Trichoderma harzianum*. Trichonitrin was obtained from the several strains of *Trichoderma harzianum* (Kulisler, 1997). Shanmugam (2001) was made purification and characterization of phytotoxin from *Trichoderma viridae*. The species of *Trichoderma* are known to inactivate the phytotoxins produced by many plant pathogenic fungi. (Sriram *et al.*2000). Culter and Le Flies (1978) reported that Trichodermin is a potent inhibitor of plant growth and produces other phytotoxic effects. It inhibits wheat coleoptile growth; phytotoxic to tobacco at high concentration and inhibits growth at lower concentrations.

From the review of literature, it was observed that very little information is available regarding the phytotoxic activity of *Trichoderma* species. The essential fact is that the determination of phytotoxic effects by *Trichoderma* species on crop plants must be needed. The positive and negative phytotoxic effects by the *Trichoderma* species on the crop plants should be determined. By knowing these effects the use of *Trichoderma* species as bio-control agent for disease management will become efficient and convincing. By keeping in mind above facts, the present investigation was carried out for the determination of phytotoxic effects of *Trichoderma* species on cereal crop plants.

MATERIAL & METHODS

Isolation of *Trichoderma* species: *Trichoderma* species were isolated from the various sources such as rhizosphere soils of irrigated and non-irrigated crop plants, seeds of different crop plants.

Extraction of Fungal metabolites from *Trichoderma* species: In the present investigation the evaluation of phytotoxins from the isolated *Trichoderma* species was carried out. The *Trichoderma* species were grown on Richard’s solution (broth). 25 ml of Richard’s broth was poured in 100 ml conical flasks. The flasks along with medium were autoclaved at 15 lbs for 20 minutes. The flasks were allowed to cool and after cooling the flasks were inoculated with 1ml spore suspension of isolated *Trichoderma* species prepared from 7 days old cultures grown on PDA slants. The flasks were incubated for 9 days at 27°C. After the incubation period, these flasks were harvested by filtration of their contents through Whatman filter paper No.1. The filtrate were collected in pre sterilized conical flasks and considered as crude toxin preparations. These preparations were tested for their toxicity.

Effect of fungal metabolites on cereal seeds: The toxicity of culture filtrate was determined by using seed germination method. Healthy seeds of cereal crop plants viz. Bajra (*Pennisetum typhoideum* L.), Jowar (*Sorghum vulgare* M.), Maize (*Zea mays* L.), Rice (*Oryza sativa* L.) and Wheat (*Triticum aestivum* L.) were collected from local market of Renapur and surface sterilized by treating with 0.1% mercury chloride solution an followed by repeated washing with sterilized distilled water. The surface sterilized seeds were soaked in crude toxin preparation for 24 hours. Then they were placed on moist blotter paper in sterilized petriplates. These seeds soaked similarly in freshly uninoculated liquid medium served as control. The percentage of seed germination was observed and data was recorded in Table 1. (Haikal,2008).

RESULTS & DISCUSSIONS

The detection of phytotoxin from the *Trichoderma* species were examined by treating of culture filtrates with seeds of selected cereal crop plants. The treated seeds were allowed for germination under vitro condition. The culture filtrates of *Trichoderma* species showed effect on seed germination, this indicates that extracellular metabolites in culture filtrates of *Trichoderma* species exhibited their effects on the seed germination; this indicates that extracellular metabolites in culture filtrate of *Trichoderma* species showed their effects on seed germination. The culture filtrates of three isolated *Trichoderma* species grown on glucose nitrate medium for seven days were tested for seed germination of five cereal crops and the results were recorded in Table 1.

The obtained results indicated that, the culture filtrates of *Trichoderma* species proved to be stimulatory for the germination of cereal crop seeds. The culture filtrate of *Trichoderma harzianum* had showed comparatively superior effects than the culture filtrates of *Trichoderma viridae* and *Trichoderma virens*, the seed germination of cereal crops. The culture filtrate of *Trichoderma harzianum* showed its results like Bajra (95%), Jowar (96%), Maize (97%), Rice (97%) and Wheat (95%). The results showed by the culture
The culture filtrate of Trichoderma viridae were Bajra (90%), Jowar (93%), Maize (95%) and Wheat (92%). The results of Trichoderma virides were Bajra (97%), Jowar (86%), Maize (90%), Rice (92%) and Wheat (88%) and the controlled results were Bajra (80%), Jowar (83%), Maize (94%), Rice (80%) and Wheat (78%). The overall results indicate that the culture filtrates of Trichoderma species proved to be stimulatory for the seed germination of cereal crop plants. The culture filtrate of isolated Trichoderma species showed no any adverse effects on the seed germination of cereal crop plants. The species of Trichoderma are known to produce a range of metabolites that may affect the growth of microorganisms and plants. The production of antibiotics such as viridian (Grove et al. 1996), trichodermin ergokonin (Kumeda et al. 1994) and viridioungins A, B and C (Harris et al. 1933) produced by different isolates of Trichoderma viridae have been involved in biological control. The species of Trichoderma are well known bio-control agents against the pathogenic fungi and nematodes. The weed control by using the Trichoderma species is still a relatively unexplored field and the few known studies in this area are restricted to Trichoderma virides only (Heraux et al. 2005). In the present investigation the culture filtrate showed very promoting effects on the seed germination of cereal seed crops.

CONCLUSION

The main objective of this investigation is that to determine the effects of metabolites through percentage of seed germination and the toxicity of secondary metabolites on the crop plants also considered. From the present investigation, the results indicated that the species of Trichoderma induces the seed germination and Trichoderma species induced the germination as well as growth of plants along with biological control, so it can be suggested that Trichoderma species can be used as safe bio-control agents that are safe for the cereal crop plants.

REFERENCES

Aspite, A., Veisturs, V. (1996). Production of biofungicide trichodermin preparation and its effect upon barley crop.Latvijas Laimstāvniecības Universitātes-Ra,283(6):3-16.

Bruckner, H., Reinecke, C., Kripp and Kiess, M. (1990). Screening, isolation and sequence determination of a unique group of polypeptide antibiotics from filamentous fungi. Proceeding of Fourth International Mycological Congress, Regensburg, Germany.224

Chet, I., Viterbo, A., Brotman, Y., and Lousky,T. (2006). Enhancement of plant disease resistance by biocontrol agent Trichoderma Life Science URL:www.weizmann.ac.il.

Cutler, H. G. and Le Files, J. H. (1978). Trichodermin: Effects on plants. Plant and Cell Physiology, 19(1):177-182.

Dennis, C. and Webster, J. (1971). Antagonistic properties of species of Trichoderma. I. Production of non-volatile antibiotics. Trans. Br. Mycol. Soc., 57:25-29

Grove, J. F., Speake, R. N., and Wart. (1996). Metabolic products of Colletotrichum capsici: isolation and characterization of acetylcolletotrichin and colletodial. J. Chem. Soc.C:230-234

Haikal, N.Z. (2008). Effect of filtrate of pathogenic fungi of soybean on seed germination and seedling parameters. Journal of Applied Sciences Research, 41(3):48-52.

Harris, G.H., Jones, E.T., Meinz, M.S. (1993). Isolation and structure elucidation of viridioungins A, B and C.Tetrahedron and Lett.34:5235-5238.

Heraux, F. M., Hallet, S. G., Weller, S. C. (2005). Combining Trichoderma viridae-inoculated compost and a rey cover crop for weed control in transplanted vegetables. Biological control. 34:21-26.

https://doi.org/10.1016/j.biocontrol.2005.04.003

Howell, C.R. (1998). The role of antibiosis in biocontrol in Trichoderma and Gliocladium. Vol.II (G. E. Harman and C. P. Kubicek Eds.)Taylor and Francis, London:173-184.

Huang, Q., Teksuza,Y.,Kikuchi,T.Nishi,A.(1995). Studies on metabolites of mycoparasitic fungi. II. Metabolites of Trichoderma koningii. Chem. Pharm. Bull., 43:223-228. https://doi.org/10.1248/cpb.43.223

Javed, A. and Ali, S. (2011). Alternative management of aproblematic weed of wheat Avena fatua L. by metabolites of Trichoderma. Chilean Journal of Agricultural Research, 71(2):205-211. https://doi.org/10.4067/s0718-58392011000200003

Kulisler, S. (1977). Efficacy of bioprodut Trichonitrin in controlling spring barley seed caused by Rhynchosporium sedalis. Ochrana Rostin UZP1, 33:215-219.

Kumeda, Y., Asao, T., Lida, A., Futami, S. (1994). Effects of ergokinon produced by Trichoderma viridea on growth and morphological development of fungi, Bok in Bohui,22:663-670.

Shanmugam, V., Sriram, S., Nandkumar, R., Raguchander, T., Balasubramanian, P. (2000). Purification and characterization of extracellular alpha-glucosidage proteins from Trichoderma viride which degrades a phytotoxin associated with sheath blight disease in rice.J.Appl.Microbiol.90 (3):320-329.

Sivasithamparam, K. and Ghisalberti, E.L. (2002). Secondary metabolism in Trichoderma and Gliocladium Vol.I.C.P.Kubicek and G.E.Harman Taylor and Francis, London:139-192.

Sriram, S., Raguchander, T.,Nandkumar, R.,Vidyasekaran, P., Samiyappan, R. (2000). Inactivation of phytotoxin produced by the rice sheath blight pathogen Rhyzoxia solani.Can.J.Mycobiol,46 (6):520-524. https://doi.org/10.1139/cjm-46-6-520

Stipanovic, R. D. and Howell, C. R. (1982). The structure of gliovira,a new antibiotic from Gliocladium viridae.J.Antibiot.35:1326-1330. https://doi.org/10.7164/antibiotics.35.1326

Tomoda, H., Huang, X. H., Nishida, H., Omura, S. (1992). Gliosporins, new inhibitors of acyl-COA: Cholesterol acyltransferase produced by Gliocladium sp.FO-1513.Production, isolation and physico-chemical and biological properties. J. Antibiot. (Tokyo) 45:1202-1206. https://doi.org/10.7164/antibiotics.43.1202
Table 1: Effect of culture filtrates of *Trichoderma* species on seed germination

| Sr. No. | Cereal crop plants       | Control | Percentage of seed germination (%) |
|---------|--------------------------|---------|------------------------------------|
|         |                          |         | *T. harzianum* | *T. viride* | *T. virens* |
| 1       | Bajra (*Pennisetum typhoideum* L.) | 80      | 95       | 90       | 87       |
| 2       | Jowar (*Sorghum vulgare* M.)     | 83      | 96       | 93       | 86       |
| 3       | Maize (*Zea mays* L.)            | 84      | 97       | 93       | 90       |
| 4       | Rice (*Oryza sativa* L.)         | 80      | 97       | 95       | 92       |
| 5       | Wheat (*Triticum aestivum* L.)   | 78      | 95       | 92       | 88       |

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