International Journal of Botany Studies
ISSN: 2455-541X; Impact Factor: RJIF 5.12
Received: 21-01-2020; Accepted: 20-02-2020; Published: 23-03-2020
www.botanyjournals.com
Volume 5; Issue 2; 2020; Page No. 65-68

Does seed priming with *Trichoderma* isolates have any impact on germination and seedling vigor of wheat

Muhammad Zohaib Anjum[1], Sofia Hayat[2*], Muhammad Usman Ghazanfar[3], Salman Ahmad[4], Muhammad Adnan[5], Imtiaz Hussain[6]

[1-4] Department of Plant Pathology, College of Agriculture, University of Sargodha, Pakistan
[5] Department of Agronomy, College of Agriculture, University of Sargodha, Pakistan
[6] Department of Animal Sciences, College of Agriculture, University of Sargodha, Pakistan

Abstract
Wheat faces many problems due to biotic and abiotic factors. Low seed germination is a severe problem which directly affects its yield and quality. *Trichoderma* is known as bio-control agent of phytopathogens but also act as plant growth promoter due to its many direct mechanisms. In present study wheat seeds were primed with three isolates of *Trichoderma harzianum* (Trico Pak, BDF 22and BDF43) to check their impact on seed germination and plant vigor. Results showed that application of *Trichoderma* has no negative impact on seed germination rather it not only enhances the rate of seed germination but also gave vigor to wheat plant and improve shoot and root growth. Isolate BDF22 showed maximum seed germination after 48 hours followed by other tested isolates with respect to control under in-vitro studies. Wheat plants treated with isolate BDF43 were erect and vigorous as compared to others. *In-vivo* results proved that isolate BDF22 gave maximum (92%) seed germination as compared to other tested isolates. On the bases of results, it is concluded that *Trichoderma* application enhances the growth rate of wheat seeds with no negative impact.

Keywords: wheat, *Trichoderma*, seed priming, germination, vigor index

1. Introduction
Wheat (*Triticum aestivum* L.) is a major cereal crop that sustains humanity. About more than 75% of the world's population is consuming wheat as a part of daily diet (Afzal *et al*., 2008) [1], whereas 35% is using it as staple food. *Trichoderma* specie is widely used in agriculture as biocontrol agent and bio-inoculants to promote plant growth. They also involve in fundamental activities that ensure the stability and productivity of agriculture and natural ecosystem (Pozo *et al*., 2004) [2]. The potential use of the *Trichoderma* species as a biocontrol agent was suggested about 85 years ago by Weindling (1932) [3]. *Trichoderma* is harmless to the environment as compare to the chemical pesticides, commonly present in agricultural soils and a wide range of habitats (Singh *et al.*, 2007) [4]. This genus is economically important due to production of enzymes, plant growth promoters and its use as commercial bio-fungicides and bio fertilizers (Faheem *et al.*, 2010; Poovendran *et al.*, 2011; Vinale *et al.*, 2014; Anjum *et al.*, 2019) [5, 6, 7, 8]. Plant growth promoting ability of *Trichoderma* is reported by many researchers (Harman *et al.*, 2004; Raats, 2012; Hajieghrari and Mohammadi, 2016; Anjum *et al.*, 2019) [9, 10, 11, 8]. *Trichoderma* as growth stimulator is attributed to many discovered mechanisms which includes mineral solubilization, root colonization, symbiosis, plant nutrient uptake, phytohormons (growth regulators), siderophores secretions and enzymes (Benitez *et al.*, 2004; Gravel *et al*., 2007; Li *et al.*, 2015) [12, 13, 14]. Ability of *Trichoderma* as plant growth promoter has been studied in many crops like tomato, tobacco, strawberries, onion, cotton, beans, apple, wheat, rice and potatoes (Windham *et al.*, 1986; Porras *et al.*, 2007; Altintas and Bal, 2008; Shanmugaiah *et al.*, 2009; Erper *et al.*, 2013; Raman, 2012; Sharma *et al.*, 2012; Doni *et al.*, 2014; Hicks *et al.*, 2014) [15, 16, 17, 18, 19, 20, 21, 22, 23]. Currently, research for plant promoting isolates of *Trichoderma* attained attention of many researchers in the world because potential of plant growth varies among different *Trichoderma* species (Martínez-Medina *et al*., 2014) [24]. Use of synthetic fertilizers is common practice by wheat growers in Pakistan but it may create health hazards, environment pollution, nutrient imbalance, soil acidity and sometime induce plant toxicity. To minimize these, there is a need to find out the best alternatives like beneficial microorganisms for wheat production. Present study was designed to evaluate the impact of *Trichoderma* isolates on seed germination, seed vigor and agronomic parameters of wheat.

2. Materials and Methods
Wheat seeds were obtained from local grain market of Faisalabad, Punjab, Pakistan and surface sterilized with 0.1% $HgCl_2$. Seed priming was performed by dipping in conidial suspension (1×10^7 ml^{-1}) of three *Trichoderma harzianum* isolates (Trico Pak, BDF 22 and BDF43) for 6 hours while control seeds were dipped in distilled water. Twenty seeds were used for each treatment, placed on per petri plates and incubated in dark at 25°C±1 to observe the rate of germination. Germination data was recorded after 48 hours. After germination, seeds were allowed to grow for seven days in petri plates to observe the effect of priming on seedling shoot and root length.
For pot experiment, wheat seeds were surface sterilized with 0.1% $HgCl_2$ and treated with conidial suspension (1×10^7 ml^{-1}) of tested *Trichoderma* isolates for 6 hours and sown in

sterilized plastic pots containing autoclaved soil. Pots received 14 hours day period with light intensity 400 Lux, and 10 hours night period in growth room (25ºC±1) till the emergence of plants. After 20 days of sowing, data of seed germination percentage, vigor index and root-shoot length were recorded.

Each treatment contained three replications. Statistix 8.1 software was used for data analysis and LSD was used to compare the treatment means.

3. Results

Results showed that all tested *Trichoderma* isolates enhanced the wheat seed germination, vigor index and promote the plant growth. Under laboratory conditions, isolate BDF22 gave maximum seed germination (87%) as compared to other treatments while control showed (72.7%) germination (Figure 1). Seed priming increased the root-shoot length of wheat. Trico Pak significantly increased the root length while BDF43 increased the shoot length as compared to other treatments (Figure 2).

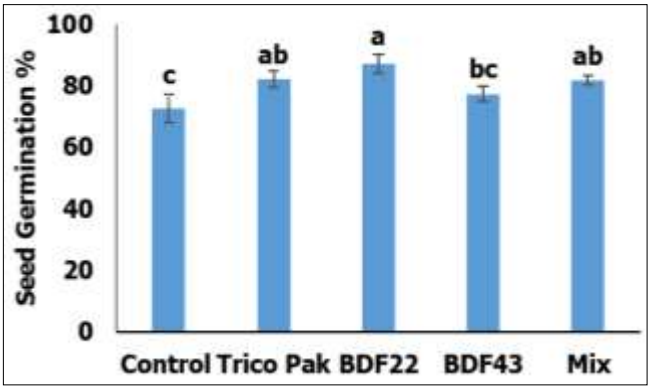

Fig 1: Effect of *Trichoderma* isolates on germination percentage of wheat seeds under laboratory conditions. Mix (Combination of Trico Pak+BDF22+BDF43). (P≤0.05).

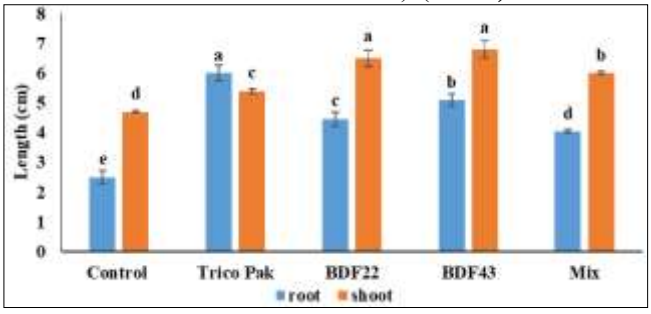

Fig 2: Effect of *Trichoderma* isolates on root-shoot length of wheat seedlings under laboratory conditions. Mix (Combination of Trico Pak+BDF22+BDF43). (P≤0.05).

In pot experiment, isolate BDF43 gave maximum (92%) seed germination percentage which was statistically similar with BDF22 as compared to others (Figure 3). Maximum vigor index was showed by BDF43 followed by BDF22, mix and Tricho Pak respectively as compared to control (Figure 4). Maximum root length was given by isolate Trico Pak whereas isolate BDF43 showed maximum shoot length as compared to all other treatments (Figure 5).

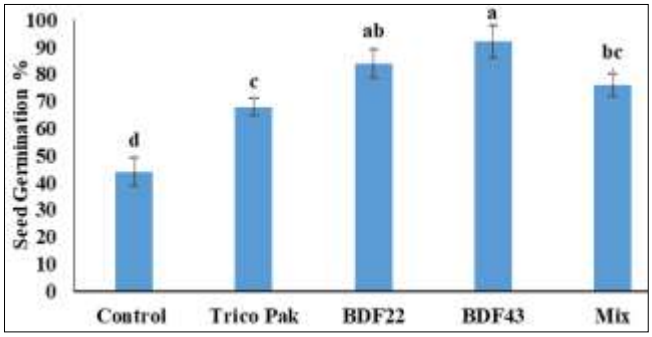

Fig 3: Effect of *Trichoderma* isolates on germination percentage of wheat seeds under pot experiment. Mix (Combination of Trico Pak+BDF22+BDF43). (P≤0.05).

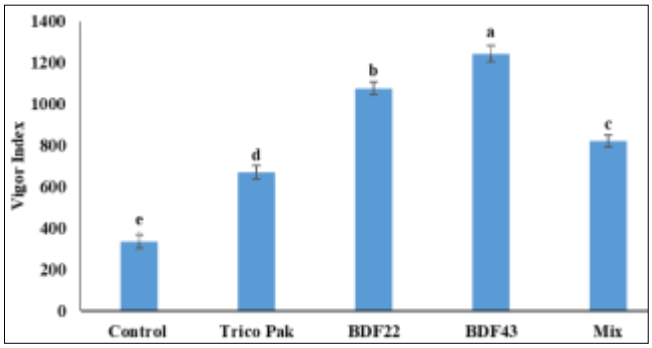

Fig 4: Effect of *Trichoderma* isolates on vigor index of wheat plants under pot experiment. Mix (Combination of Trico Pak+BDF22+BDF43). (P≤0.05).

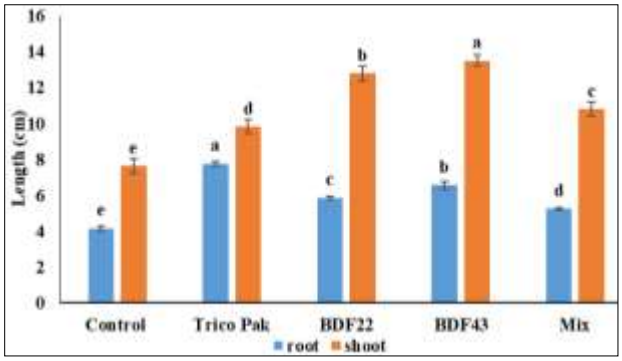

Fig 5: Effect of *Trichoderma* isolates on shoot-root length of wheat plants under pot experiment. Mix (Combination of Trico Pak+BDF22+BDF43). (P≤0.05).

4. Discussion

Trichoderma isolates have long been not only recognized as biological agents but also for their ability to increase root growth and development, crop productivity, resistance to abiotic stresses, and uptake and use of nutrients. *Trichoderma spp.* proved their potential as bio-stimulant (Bhardwaj *et al.*, 2014) [25]. Some studies also confirmed that *Trichoderma* isolates produces many phytohormones like Indol acetic acid which directly enhance the plant growth and some enzymes that promote root-shoot growth (Harman *et al.*, 2004; Vinale *et al.*, 2012) [9, 26]. Our results are similar with the findings of Kucuk (2014) [27] who used two isolates of

Trichoderma harzianum and found that both isolates increased the plant hight, root and shoot dry matter as compared to control treatment. Many antagonists especially some isolates of *Trichoderma* act as plant growth promotor in the absence of pathogens (Kleifeld and Chet, 1992) [28]. Different mechanisms trigger by *Trichoderma* species directly influence on germination of seeds and vigor (Doni *et al.*, 2014) [22]. As questioned impact of *Trichoderma* isolates on seed germination, present findings of laboratory and pot experiment confirmed that isolate BDF22 and BDF43 significantly increased the seed germination percentage. Plant-*Trichoderma* symbiotic interaction may lead to cross talk which results specific gene expression that directly involves in plant growth (Vinale *et al.*, 2008) [29]. Biotic and abiotic conditions may interfere in Plant-*Trichoderma* interaction. Better understanding for this interaction can be observed when seeds are sown in soil. We observed in pot experiment that BDF43 showed more germination rate and promote shoot-root length as compared to control and other treatments. Present results are matched with the findings of Rabeendran *et al*, (2000) [30] who observed the growth promotion of lettuce and cabbage seedlings by the application of *Trichoderma* isolates in glass house conditions. Tomato seeds treated with *T. harzianum* increases the germination speed and germination ratio (Mastouri *et al.*, 2010) [31]. Mukhtar, (2008) [32] also confirmed that okara seed germination index was increased when they treated with *T. harzianum.*

5. Conclusions

In present study, seed priming with *Trichoderma* isolates promoted the percent seed germination, vigor index and root-shoot growth. On the basis of results, it is concluded that *Trichoderma* isolates can be used as plant growth promoters which may be alternative to synthetic molecules and chemical fertilizers.

6. References

1. Afzal SN, Haque MI, Ahmedani MS, Rauf A, Munir M, Firdous SS, *et al*. Impact of stripe rust on the kernel weight of the wheat varieties sown in rain fed area of Pakistan. Pakistan Journal of Botany. 2008; 40(2):923-929.
2. Pozo MJ, Baek JM, Garcia JM, Kenerley CM. Functional analysis of tvsp1, a serine protease-encoding gene in the biocontrol agent *Trichoderma virens*. Fungal Genetics and Biology. 2004; 41(3):336-348.
3. Weindling R. *Trichoderma lignorum* as a parasite of other soil fungi. Phytopathology, 1932; 22(8): 837-845.
4. Singh A, Srivastava S, Singh HB. Effect of substrates on growth and shelf life of *Trichoderma harzianum* and its use in biocontrol of diseases. Bio-resource Technology. 2007; 98(2):470-473.
5. Faheem A, Razdan VK, Mohiddin FA, Bhatt KA, Sheikh PA. Effect of volatile metabolites of *Tricoderma spp*. against seven fungal plant pathogens in-vitro. Journal of Phytology. 2010; 2(10):34-37.
6. Poovendran P, Kalaigandhi V, Parivugna V. In vitro study of antagonistic effect of *Trichoderma* sp., on tea plant pathogen, *Phomopsis theae.* Archives of Applied Science Research. 2011; 3(4):352-358.
7. Vinale F, Manganiello G, Nigro M, Mazzei P, Piccolo A, Pascale A, *et al*. A novel fungal metabolite with beneficial properties for agricultural applications. Molecules. 2014; 19:9760-9772.
8. Anjum MZ, Ghazanfar MU, Hussain I. Bio-efficacy of Trichoderma isolates and *Bacillus subtilis* against root rot of muskmelon *Cucumis Melo* L. caused by *Phytophthora drechsleri* under controlled and field conditions. Pakistan Journal of Botany. 2019; 51(5):1877-1882.
9. Harman GE, Charles R, Howell CR, Viterbo AD, Chet I, Lorito M, *et al*. *Tricoderma* species- opportunistic, a virulent plant symbiont. Nature review, Microbiology. 2004; 2(1):43-56.
10. Raats PAC. Effect of Trichoderma species on damping off diseases incidence, some plant enzymes activity and nutritional status of bean plants. International Journal of Agriculture, Environment and Bioresearch. 2012; 2:13-25.
11. Hajieghrari B, Mohammadi M. Growth-promoting activity of indigenous Trichoderma isolates on wheat seed germination, seedling growth and yield. Australian Journal of Crop Science. 2016; 10(9):1339-1347.
12. Benitez T, Rincon AM, Limon MC. Biocontrol mechanisms of *Trichoderma* strains. International Microbiology. 2004; 7(4):249-260.
13. Gravel V, Antoun H, Tweddell RJ. Growth stimulation and fruit yield improvement of greenhouse tomato plants by inoculation with Pseudomonas putida or *Trichoderma atroviride*: Possible role of Indol acetic acid (IAA). Soil Biology and Biochemistry. 2007; 39:1968-1977.
14. Li RX, Cai F, Pang G, Shen QR, Li R, Chen W, *et al*. Solubilization of phosphate and micronutrients by *Trichoderma harzianum* and its relationship with the promotion of tomato plant growth. PLoS ONE. 2015; 10:e0130081.
15. Windham MT, Elad Y, Baker R. A mechanism for increased plant-growth induced by *Trichoderma spp*. Phytopathology. 1986; 76:518-521.
16. Porras M, Barrau C, Romero F. Effects of soil solarization and *Trichoderma* on strawberry production. Crop Protection. 2007; 26:782-787.
17. Altintas S, Bal U. Effects of the commercial product based on *Trichoderma harzianum* on plant, bulb and yield characteristics of onion. Scientia Horticulturae. 2008; 116:219-222.
18. Shanmugaiah V, Balasubramanian N, Gomathinayagam S, Monoharan PT, Rajendran A. Effect of single application of *Trichoderma viride* and *Pseudomonas fluorences* on growth promotion in cotton plants. African Journal of Agricultural Research. 2009; 4:1220-1225.
19. Erper I, Turkkan M, Atanasova L, Druzhinia IS, Karaca GH, Cebi-Kilicoglu M, *et al*. Integrated assessment of the mycoparasitic and phytostimulating properties of *Trichoderma* strains against *Rhizoctonia solani*. Bulgarian Journal of Agricultural Science. 2013; 19:737-743.
20. Raman J. Response of Azotobacter, Pseudomonas and Trichoderma on growth of apple seedling international conference on biological and life sciences, IPCBEE, IACSIT Press, Singapore, 2012.
21. Sharma P, Patel AN, Saini MK, Deep S. Field demonstration of *Trichoderma harzianum* as a plant

growth promoter in wheat (*Triticum aestivum* L). The Journal of Agricultural Science. 2012; 4:65-73.
22. Khan AA, Sinha AP, Rathi YPS. Plant growth promoting activity of *Trichoderma harzianum* on rice seed germination and seedung vigour. Indian Journal of Agricultural Research. 2005; 39(4):256-262.
23. Doni F, Anizan I, Che-Radziah CMZ, Salman AH, Rodzihan MH, Yusoff WMW, *et al*. Enhancement of rice seed germination and vigor by *Trichoderma spp*. Engineering, Technology & Applied Science Research. 2014; 7:4547-4552.
24. Hicks E, Bienkowski D, Braithwaite M, McLean K, Fallon R, Stewarti A, *et al*. *Trichoderma* strains suppress Rhizoctonia diseases and promote growth of potato. Phytopathologia Mediterranea. 2014; 53:502-514.
25. Martínez-Medina A, Del Mar Alguacil M, Pascual JA, Van Wees SCM. Phytohormone profiles induced by *Trichoderma* isolates correspond with their biocontrol and plant growth-promoting activity on melon plants. Journal of Chemical Ecology. 2014; 40:804-815.
26. Bhardwaj D, Ansari MW, Sahoo RK, Tuteja N. Bio-fertilizers function as key player in sustainable agriculture by improving soil fertility, plant tolerance and crop productivity. Microbial Cell Factories. 2014; 13:66.
27. Vinale F, Sivasithamparam K, Ghisalberti EL, Ruocco M, Wood S, Lorito M, *et al*. Trichoderma secondary metabolites that affect plant metabolism. Natural Product Communication. 2012; 7:1545-1550.
28. Kucuk C. Enhanced root and shoot growth of wheat (*Triticum aestivum* L.) by *Trichoderma harzianum* from Turkey. Pakistan Journal of Biological Sciences. 2014; 17(1):122-125
29. Kleifeld O, Chet I. *Trichoderma harzianum* interaction with plants and effect on growth response. Plant and soil. 1992; 144(2):267-272.
30. Vinale F, Sivasithamparamb K, Ghisalberti EL, Marra R, Barbetti MJ, Li H, *et al*. A novel role for Trichoderma secondary metabolites in the interactions with plants. Physiological and Molecular Plant Pathology. 2008; 72:80-86.
31. Rabeendran N, Moot DJ, Jones EE, Stewart A. Inconsistent growth promotion of cabbage and lettuce from Trichoderma isolates. in proceedings of the new zealand plant protection conference, 2000, pp.143-146.
32. Mastouri F, Bjorkman TH, Harman GE. Seed treatment with *Trichoderma harzianum* alleviates biotic, abiotic, and physiological stresses in germinating seeds and seedlings. Biological Control. 2010; 100(11):1213-1221.
33. Mukhtar I. Influence of *Trichoderma* species on seed germination in Okra. Mycopathology. 2008; 6(1&2):47-50.