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Comparative Analysis of Effects of Seed Biopriming on Growth and Development in Different Pulses: Pea, Lentil, Red Gram and Chickpea

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A B S T R A C T

Pulses are economically and nutritionally important crop in India. It continuously faces biotic and abiotic challenges. In this study we analysed the potentiality of *Trichoderma* spp. in germination and development of pulses. The pulse crops were taken as Pea, Lentil, chickpea and Red gram. All pulse seeds were treated with *Trichoderma* spp. suspension before sowing. We analysed the effect under parameters such as germination, total average length. Total average root and shoot length individually to check the effect of treatments in growth promotion of root and shoot. Fresh weight and dry weight was also recorded to observe more response of treatment on plants. All treatments were tested against a control which is untreated. Significant difference was observed in response of treatment between treated and untreated plants. It is showing positive effect on growth and development of plants under above parameter. These results will help in exploring more in the future.

Introduction

Pea (*Pisum sativum*) is highly protein rich and nutritional crop of India. It is consumed as vegetable as well as spilt grains are utilized as dal. Straw is also used as fodder for cattle. It's a cool season or rabi crop and reported to be first crop grown by human civilization (Dhanraj Patel *et al.*, 2017). It experience many stresses which effect its productivity like freezing stress, reduced pod yield (Zhang *et al.*, 2016). Lentil (*Lens culinaris*) commonly known as masoor. It is a high fiber and contains 23.7% protein (Dahal *et al.*, 2017) provides ample amounts of essential amino acids for development of body (Yadav *et al.*, 2007). It's frequently exposed with lot diseases such as *Aschochyta* blight, anthracnose or soil born disease like *sclerotinia* white mold (Agrios, 2005).

Pigeonpea (*Cajanus cajan*) is one of the major grain legume (pulse) crops of tropics and sub-tropics. It has capacity to recycle the soil fertility by fixing atmospheric nitrogen (Reddy *et al.*, 1990). The protein content of dry split pigeonpea grains (dal) is about 24 percent (Singh *et al.*, 1993). The crop is plagued by various diseases of fungal, nematode, viral and bacterial origins (Kannaiyan *et al.*, 1984; Nene *et al.*, 1989). Chickpea (*Cicer arietinum*) third in the world among pulse crops after peas and beans with an area of 6.3 million hectare with an average yield of 7330 thousand tonnes (Agricoop, 2014-15). It is faces challenges against many pathogen in which soli born diseases are more sever such as *fusarium* wilt, *sclerotinia* rot, *sclerotium* disease etc. (Bhatti *et al.,* 1992). 9-41% yield loss has been reported in chickpea (Pandey *et al.,* 2017).

The application of *Trichoderma* species can control a large number of foliar and soil borne fungi i.e. *Fusarium* spp.*, R. solani*, *Pythium* spp.*, S. sclerotiorum*, *S. rolfsii*, in vegetables, field, fruit and industrial crops (Tran, 1998; Ngo *et al.*, 2006). Application of *Trichoderma* enhances the antioxidant activity which perform best against stress condition mostly in case of biotic stress (Sing *et al.*, 2013). It's also reported that mortality rate is less under Trichoderma application (Singh et. al.2014). It has strong biocontrol, mycoparasitic and enzymatic activity against pathogens (Mohiddin *et al.*, 2010) thus having strong capacity to manage above diseases. It's also compatible with other fungicides.

Trichoderma spp. can promote growth of plants significantly (Zhang *et al.*, 2016). In our study we focused on growth promoting property of *Trichoderma* spp. on different pulses to check whether the different crop respond differently to treatment? And do all pulse crops shows positive effect of treatments. We took 4 crops pea, lentil, Red gram and chickpea. Seeds were pre-treated with *Trichoderma* culture and then studied for various aspects. We got following significant results.

Materials and Methods

Preparation of culture

Pure culture of *Trichoderma* spp. was prepared (Fig. 1). Seeds were treated when culture developed fully and sporulation was observed on 6th day after inoculation on PDA plate. Culture was diluted with distilled water and seeds were soaked mixing CMC solution for proper adhesion of *Trichoderma* fungus on seeds. It was soaked for 4-5 hrs then sown on pots filled with sterile soil and grown under controlled condition in green house.

Germination test

Observations were taken 6 days after sowing and second observation was taken on 10th day after sowing. Two replication of control was taken and three replications of treatments were taken. Observation was taken for each pot and value was averaged for both treatment and control.

Average total length

Average total length was recorded in cms. First observation was taken on 8th day after sowing and then it was repeated at interval of four days for four times.

Total average root and shoot length

Average root and shoot length were recorded in cms 23rd days after sowing by uprooting the plants from the plants.

Measuring fresh weight and dry weight

Immediately after uprooting of plants on 23rd day, fresh weight measured on electronic balance in gms. Dry weight measured for oven dried sample (60^{0}C, overnight).

Results and Discussion

Test of germination

Average of germination for crops, pea, lentil, red gram and chickpea were taken. These crops were sown with treatment and without treatment of seeds under controlled condition.

Highest germination was observed in pea and chickpea among treated and control whereas lowest vale is 7.33 for chickpea under control which is without *Trichiderma* spp. treatment.

Average total length

Treated plants showed more average length than the untreated plants.

We observed that all seeds for which pre sowing treatment was given with *Tirchoderma* spp. was showing enhanced germination than control (Table 1). It shows that priming with Trichoderma prior to sowing, giving positive effect on germination. Whereas we also observed that among pulses response to the treatment varies 8.66 to 9.33 ranges. Shows that different pulse species have different impact of seed treatment on germination however it is observed positive than the control in all pulses.

On the total length of the plants if we see individually for each crop we can observe that growth has been enhanced and it was recorded since starting of observation. Treated plants are showing more length than control plants in each crop. On the 4rth observation lentil is showing more growth difference in treated condition against control. Other pulses such as pea, Red gram and chickpea also observed to positively correlated with the treatments of Trichoderma as these are also showing enhanced growth under treated condition against control (Table 2).

It is interesting that effects of treatment not only enhanced total length or just shoot length; it has significantly promoted the root length in each pulse crop, which is important factor in all pulse crops. It will not only increase the vigour and growth of plants but also the capacity to tolerate biotic and abiotic stresses (Table 3). Difference in root length is recorded highest for lentil followed by chickpea. Fresh weight and dry weight both were recorded high in treated sample compare to the control (Table 5 and 6).

It is very positive indication that treatment can bring good vigour in plants and promotes both root and shoot growth. Root growth observed to be more promoted (Table 4).

Fig.1 Pure culture of *Trichoderma* spp. used for seed treatment

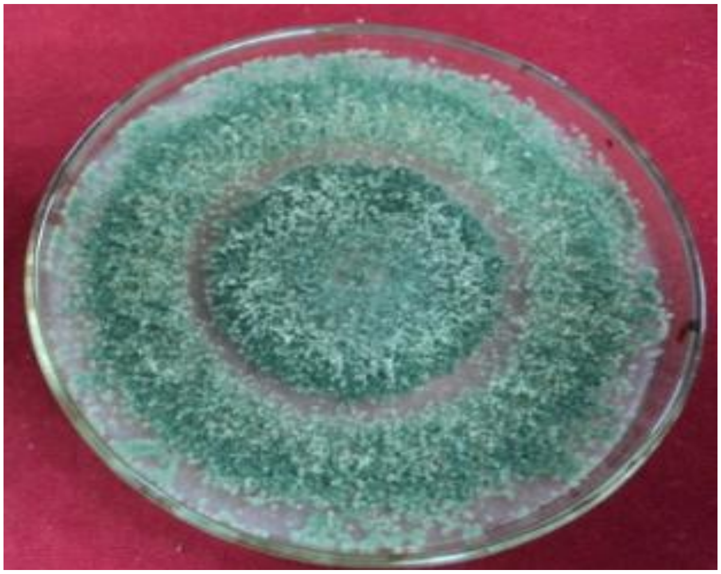

Table.1 Average numbers of germinated seeds in pots

Name of crop	Average value of control	Average value of treatments
Pea	7.66	9.33
lentil	8.33	9
Red gram	8	8.66
Chickpea	7.33	9.33

Table.2 Average total length of plants in pots obtained and observation was recorded at 4 days of interval from sowing date

Name of crop	Average value of Ist observation (cms)	Average value of 2nd observation (cms)	Average value of 3rd observation (cms)	Average value of 4th observation (cms)
Pea				
Control	1.37	2.96	3.70	4.70
treatment	2.11	3.21	4.70	6.43
Lentil				
control	2.50	5.56	8.50	10
Treatment	2.73	6.65	8.74	11.80
Red gram				
control	1.33	3.80	6.16	7.33
Treatment	1.70	4.65	7.07	8.35
chickpea				
control	2.88	4.5	6.86	7.5
Treatment	2.96	5.2	7.33	8.6

Table.3 Total average root length was recorded on 23rd days after sowing

Name of crop	Average value of control (cms)	Average value of treatments(cms)
Pea	6.50	11.83
lentil	12.75	13.00
Red gram	10.50	15.08
Chickpea	10.23	12.25

Table.4 Total average shoot length was recorded on 23rd days after sowing

Name of crop	Average value of control(cms)	Average value of treatments(cms)
Pea	9	9.43
lentil	11.3	13.21
Red gram	10.90	11.25
Chickpea	10.60	12.31

Table.5 Average dry matter in gms

Name of crop	Root		Shoot	
	Control	Replication	Control	Replication
pea	0.20	0.22	0.31	0.38
lentil	0.057	0.066	0.086	0.15
Red gram	0.28	0.33	0.32	0.37
chickpea	0.17	0.22	0.34	0.38

Table.6 Average fresh matter in gms

Name of crop	Root		Shoot	
	Control	Replication	Control	Replication
pea	1.33	2.65	2.51	3.37
lentil	0.23	0.25	0.64	0.78
Red gram	2.23	2.29	1.39	2.16
chickpea	2.2	2.73	2.07	2.85

Seed treatment of pulse seeds with the, resulted in enhanced growth over the normal sown seed. It can help in increasing vigour of plants. Increased vigour can make plants able to tolerate abiotic stress such as drought and salt tolerance.

In view of biotic stress it can make plants tolerant for soli borne diseases such as *Fusarium* wilt, *Sclerotonia* rot by its antagonistic and competitive ability, also to withstand against insect injury.

In some cases it also been reported that the treatment with *Trichoderma* can induce defence response (Benítez *et al.*, 2004). It only provides plant defense against microbial stress but also respond well to salt stress (Brotman *et al.*, 2013).

It can be further explored for the other crops and studying the nature of disease/tolerance resistance in crops. Especially for soil and root pathogen because growth promotion is more compare to untreated seeds. Other than pulse crops also it can be useful treating seed with *Trichoderma*, for growth promotion and disease tolerance as it is not a costly affair.

Future prospects

Trichoderma is widely present, its isolation and culturing is less tedious (Howell, 2003), thus making this biocontrol agent more accessible. It can be applied in mixed cropping pulses along with cereals, which will increase soil fertility better than the unprimed crops. It compatible with most of the chemicals (Bhai and Thomas, 2010) hence, it can be successfully utilize with other pesticides and fertilizers thus will reduce cost of cultivation. Most importantly it is also compatible with the other biocontrol microorganism in consortium (Singh *et al.*, 2012) and this property can be explored as further in crop protection programmes.

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