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Root trainer study for effective comparison of seed treatments in cotton

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ABSTRACT : Present study was conducted to select suitable seed treatments to grow healthy and vigorous seedlings. Seedlings were raised in root trainers since they are easy to maintain, will allow the root to grow straight (without getting curled) downward for accurate observation and will not break while taking observations. Three different mediums were used *viz.,* FYM, cotton stalk compost and vermi compost in combination with soil (50%-50%). Total 10 different seed treatments were tested for seed germination and seedling growth. Seedling growth was assessed for shoot length, root length, collar diameter, fresh weight, dry matter production. Germination was found early (3 DAS) in *P. putida*, *P. fluorescence* and *Tricoderma* (*T. harzianum*). The highest shoot length as well as root length was obtained with *P. putida* closely followed by treatment with *P. fluorescence* in cotton stalk soil substrate.

Key words : *P. fluorescence*, *P. putida*, root trainer, seed treatments

Seed treatment is widely recognized as an economical and feasible measure to obtain superior germination with vigorous healthy seedlings, which in turn, determine the plant stand and final yield of a crop. Seed application of Plant Growth Promoting *Rhizobacteria* (free living soil borne bacteria) or seed bacterization has been proven as an effective way to enhance germination and plant growth in various crops. It is reported that PGPR produce phytohormones or growth regulators that cause crops to have increased root growth and increased amount of fine roots for better uptake of water/nutrients. Cotton is an important cash crop of India which during seed germination becomes vulnerable to seed/soil borne diseases as well as soil moisture stress during scanty rainfall. Cotton seed treatment with PGPR has been observed to be useful for obtaining superior germination, management of various seed/soil borne diseases and improved growth and yield (Murugesan and Kavitha, 2009 and Mahdiyeh Mansoori *et al.,* 2013 in cotton). *Trichoderma* sp is a bioagent which is widely known to influence germination and plant growth in various crops. In cotton, *Trichoderma* seed treatment has been reported to impart resistance to seed/soil borne diseases, enhanced germination and seedling growth (Hanson, 2000 and Shanmugaiah *et al.,* 2009). Agronomic factors such as plant nutrition as well as the physical properties of soil in which the seeds are sown also play important role in determining the seedling vigor. Among the nutrients, though Silicon (Si) is not considered an essential element for plant growth, some silicates have been found to positively influence plant growth and development (Tomar and Shastry, 2006 in cotton, Prabhu *et al.,* 2006 in cotton). Silicon is known to produce and accumulate antifungal phenolic compounds and defense related enzymes for improved resistance to diseases. A comparative study of above treatments, using three different substrates such as FYM, Vermicompost and cotton stalk compost was taken up. FYM and vermi compost are widely used as source of NPK. Since no sufficient information on the role of cotton stalk compost, which is also a rich source of NPK (Manjunatha and Ravi, 2013) in providing a healthy plant at seedling stage, is available, cotton stalk compost

was included as one of the substrate in the present study. The study was conducted in root trainers filled with above three substrates since they are easy to maintain, will allow the root to grow straight (without getting curled) downward for accurate observation and will not break while taking observations.

The three manures *viz.,* FYM, cotton stalk compost and vermicompost were taken in combination with soil in 50-50 per cent (1:1) concentration. Ten treatment agents including Plant Growth Promoting Rhizobacteria's (*Bacillus* spp., *Pantoeae dispersa, Pseudomonas putida, Pseudomonas fluorescence, Cedaceae davisae*), Trichoderma in three different formulations, Potassium silicate in powder as well as liquid form and Humus were used as seed treatment. The seeds were soaked in formulations which were liquid and slurry treated with formulations which were dry powder. All the treated seeds were sufficiently dried before sowing. Untreated seeds served as control.

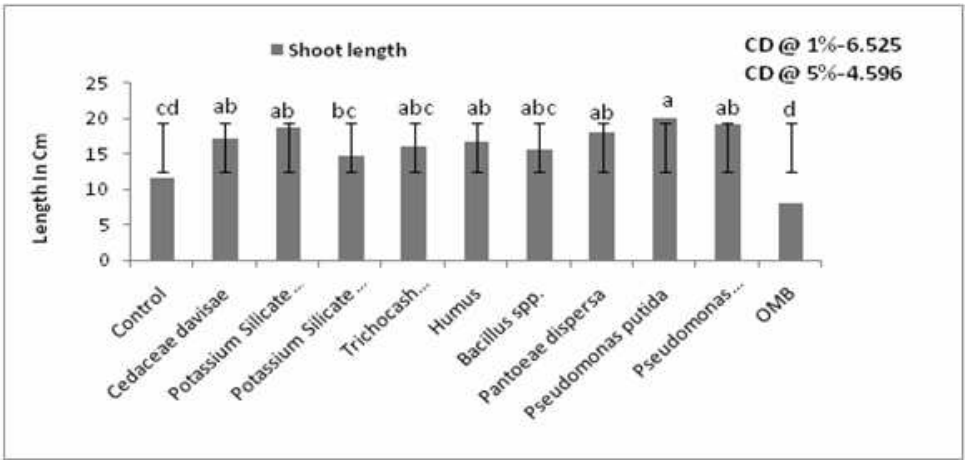
Good quality Jai *Bt* seeds which were Imidacloprid treated was the study material. Pretreated seeds were sown in root trainers (17 x7cm dimension) containing a mixture of cotton stalk compost, FYM and vermi compost, each of them mixed with soil in 1:1 ratio. Single treated seed was sown in each root trainer for each type of substrate and each treatment with two replications.

Adequate care and maintenance were taken till 20 days after sowing. . The effects were assessed periodically through counting germination at 3, 5 and 7 DAS etc. 20 DAS seedlings from each treatment were uprooted very carefully to estimate the seedling biomass. The seedlings were measured for shoot length, collar diameter, root length and total oven dry weight (leaf, shoot and root components). Leaf, shoot and root were oven dried at 50OC for 96 hours until the constant weight is obtained. The germination and growth data were analyzed statistically by RBD using computer software package WASP for determining the morphological growth variation.

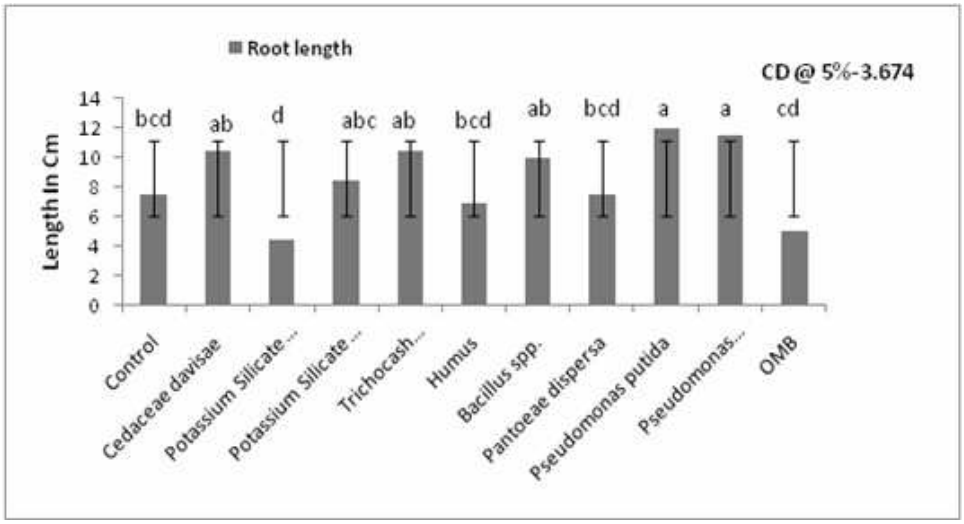
FYM, vermicompost and cotton stalk compost are known to be richest sources of N, P K. Studies have been reported on the positive impact of using FYM and vermicompost for obtaining superior germination and seedling growth. Sufficient information on the role of cotton stalk compost in providing a healthy plant at seedling stage has not been determined. Addition of microbial and fungal cultures to these media has been observed to further enhance the seedling emergence and growth, especially with respect to shoot length and root length. Studies

Table 1. Effect of seed treatments on the course of seedling emergence

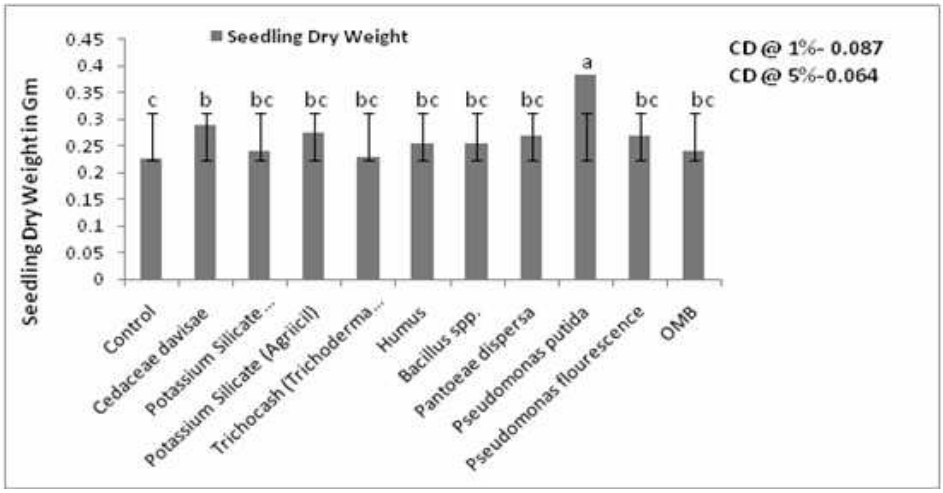
S. No.	Substrate	Complete emergence of seedlings (DAS) v/s. treatments		
		3	5	7
1	Soil+ cotton stalk	*Pseudomonas putida, P. flourescence*	*Cedaceae davisae,* Potassium silicate (Agriicil), Humus, *Bacillus* spp	Control, Potassium silicate (powder), Trichocash (*Trichoderma harzianum*), *Pantoeae dispersa,* Formulation of *Tricoderma* sp
2	Soil+FYM	Trichocash (*Trichoderma harzianum*), *Pseudomonas putida, P. flourescence*	*Cedaceae davisae,* Potassium silicate (Agriicil), Humus, *Pantoeae dispersa*	Control, Potassium silicate (powder), *Bacillus* spp, Formulation of *Tricoderma* sp
3	Soil+vermi compost	*Pseudomonas putida, Pseudomonas, fluorescence*	*Cedaceae davisae,* Potassium silicate (powder), Trichocash (*Trichoderma harzianum*), Humus, *Pantoeae dispersa*	Control, Potassium silicate (Agriicil), *Bacillus* spp, Formulation of *Tricoderma* sp



a. Shoot length



b. Root length



c. Seedling dry weight

Fig. 1. Effect of treatments in cotton stalk media on root length, shoot length and dry weight

Table 2. Effect of treatments on seedling growth parameters

S. No.	Treatments	Soil + cotton stalk			Soil+FYM			Soil+vermi compost		
		Shoot length	Root length	Seedling dry weight	Shoot length	Root length	Seedling dry weight	Shoot length	Root length	Seedling dry weight
1	Control	11.500	7.500	0.225	11.500	5.500	0.185	9.000	6.500	0.266
2	*Cedaceae davisae*	17.000	10.500	0.290	8.250	3.000	0.164	15.500	8.000	0.325
3	Potassium silicate (Powder)	18.500	4.500	0.240	17.500	5.000	0.317	13.000	5.000	0.181
4	Potassium silicate (Agriicil)	14.500	8.500	0.275	19.000	8.000	0.316	13.500	9.000	0.315
5	Trichocash (*Trichoderma harzianum*)	16.000	10.500	0.230	15.500	7.500	0.355	13.000	9.000	0.245
6	Humus	16.500	7.000	0.255	15.500	6.000	0.344	15.000	11.000	0.194
7	*Bacillus* spp	15.500	10.000	0.255	18.500	4.500	0.328	18.000	8.500	0.295
8	*Pantoeae dispersa*	18.000	7.500	0.270	16.500	5.500	0.239	15.500	9.000	0.241
9	*Pseudomonas putida*	20.000	12.000	0.385	22.000	10.500	0.393	18.500	11.500	0.329
10	*P. flourescence*	19.000	11.500	0.270	19.500	10.000	0.364	20.000	12.500	0.351
11	Formulation of *Tricoderma* sp	8.000	5.000	0.240	13.000	3.500	0.097	11.500	4.500	0.197
	CD (p=0.01)	6.525	——	0.087	Non Significant	3.371	Non Significant	——-	——-	Non Significant
	CD (p=0.05)	4.596	3.674	0.064	Non Significant	2.370	Non Significant	5.557	3.868	Non Significant

on seedling growth parameters can be conducted under controlled environment using suitable containers such as root trainers. The treatments did not differ for the final germination percentage; however there was significant difference in the speed of germination and emergence among the treatments. Treatments with *Pseudomonas putida* and *P. fluorescence* consistently gave highest 3rd day count in all three media substrates (Table 1). The seed treatments significantly enhanced seedling growth parameters as observed on their differences in shoot length, root lengths, stem girth and seedling dry weight compared to untreated control (Table 2). The highest shoot length as well as root length was obtained with *P. putida* closely followed by treatment with *P. fluroscence*. The data found numerically different but statistically non-significant for shoot length and seedling dry weight in substrates such as soil FYM and soil vermi compost. FYM vermi compost is widely used as source of NPK. However, in the present study cotton stalk compost has given superior results and therefore shows considerable promise as a replacement for FYM and vermicompost. It is also cheaper and easily available. Treatments with K silicate and *Cedaceae davisae* were also found effective with respect to the above traits followed by other treatments though, the values were lower than *P. putida* and *P. fluorescence*. Furthermore, *P. putida* gave significantly higher seedling dry weight in cotton stalk media (Fig 1). Addition of microbial cultures *P. chrysosporium* and *Azotobacter* was found to enhance the cotton stalk compost which can help in high germination and plant stand (Osama, 2013). There was no significant difference for Stem girth among the treatments. Seed treatment with *P. putida* performed superior in stimulating plant growth in soil+ cotton stalk compost and soil+ FYM as well as soil + vermicompost.

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