Effect of native *Trichoderma* isolates on the plant growth of rice (*Oryza sativa* L.) plant

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Abstract

In this study of plant growth promotion different parameter of rice viz. shoot, root length, fresh weight and dry weight of the rice plant were taken. The highest shoot length of rice plants was observed when the SVP Si 10 was applied in pots which increase the length up to 44.27 % over the control. Root length of rice plants revealed that highest root length was observed in the pots sown with soil treated with isolates SVP Si 06 (19.51 %). The flag leaf length of rice plants shows that highest leaf length was observed in isolates SVP Si 17 (39.34 %). In all the isolates SVPP-Si 6 (39.34 %) was found to be highest in increasing the fresh weight. The lowest percent increase was found in SVPP-Si 04 (2.10%). In all the isolates SVPP-Si 03 (35.00 %) was found to be highest in increasing (*i.e.* 0.94 g) the dry weight of the plant.

Keywords: Plant growth, rice, *Trichoderma* isolates.

Paper cited: Rahul, S.N., Khilari, K., Prasad, C.S., Singh, R., Mishra, P. and Tomar, A. (2016). Effect of native *Trichoderma* isolates on the plant growth of rice (*Oryza sativa* L.) plant. *South Asian Journal of Food Technology and Environment*, 2(2): 408-412.

Introduction

Rice is one of the most important food crop of India and second of the world. It feeds more than 50 % of the world population. It is the staple food of most of the people of South-East Asia. Asia holds near about 90 % to 91 % of world's rice area and production respectively. Among the rice growing countries, India having the largest area under rice in the world and in case of production it is second after China. However, productivity of India is much lower (13th) than that of Egypt, Japan, China, and Vietnam, USA & Indonesia and also the average productivity of the world. It contributes 42 % of total food grains production and 45 % of the total cereal production in the country. Each and every part of the plant have various use in society. It is also used in medicine. Rice bran oil is used as medicine as well as cooking oil (The Economic Times Agriculture 2016).

India is the second largest producer of rice after China which was 124.04 million tonne in 2015-2016. This was 1.79% less than the previous year (The Economic Times Agriculture 2016). *Trichoderma* spp. recently was suggested as a Plant Growth Promoting Fungi (PGPF) due to their ability to produce siderophores, phosphate-solubilizing enzymes, and phytohormones (Doni *et al.*, 2013).

Materials and Methods

All *Trichoderma* isolates were isolated previously from rhizospheric and non rhizospheric soil of different areas. The acquired sequences were submitted to the NCBI and the accession numbers were obtained as given in Table 1. Pot experiments were conducted in Completely Randomized Block Design with three replications to evaluate the performance of the most efficient isolates of *Trichoderma* as plant growth promoters.

The all twenty native isolates of *Trichoderma* was grown on wheat grains which were soaked in ten per cent dextrose and the grains coated with *Trichoderma* were used after fifteen days. *Trichoderma* isolates were multiplied on wheat grain medium prior to experimentation. Ten seeds of cultivar 1121 were sown in 15 cm diameter plastic pots filled with 1 kg soil inoculated with 10 days old culture of the mass multiplied *Trichoderma* (@ 10 g/kg soil) at one week before sowing (Nene *et al.*, 1981). The observations on the plant growth promotion were taken after 35 days of sowing.

Results and Discussion

In this study different parameter of rice viz. shoot, root length, fresh weight and

dry weight of the rice plant were taken, results are shown in Table 2. The highest shoot length of rice plants was observed when the SVP Si 10 was applied in pots which increase the length up to 44.27 % over the control. Root length of rice plants revealed that highest root length was observed in the pots sown with soil treated with isolates SVP Si 06 (19.51 %) isolates followed by SVP Si 12 (17.78 %).

Gangwar (2013) used *Trichoderma* isolates with two isolates of *Pseudomonas* which was isolated from the rice field and tested them as plant growth promotion and compared them with chemical. He found that root length (100.15%) and shoot length (50.06%) was recorded with FLP 88 and *T. harzianum*, respectively.

Table 1: Accession numbers obtained from NCBI after submission of sequences to the gene bank

S. No.	<i>Trichoderma</i> isolates	NCBI identification	Obtained accession no. form NCBI
1.	SVPP-Si 1	<i>Trichoderma longibrachiatum</i>	KU215919
2.	SVPP-Si 2	<i>Trichoderma asperellum</i>	KU215913
3.	SVPP-Si 3	<i>Trichoderma asperellum</i>	KU215915
4.	SVPP-Si 4	<i>Trichoderma atroviridi</i>	KU215916
5.	SVPP-Si 5	<i>Trichoderma asperellum</i>	KU215914
6.	SVPP-Si 6	<i>Hypocrea lixii</i>	KU215917
7.	SVPP-Si 7	<i>Trichoderma longibrachiatum</i>	KU215918
8.	SVPP-Si 8	<i>Trichoderma harzianum</i>	KU215926
9.	SVPP-Si 9	<i>Trichoderma harzianum</i>	KU215920
10.	SVPP-Si 10	<i>Trichoderma harzianum</i>	KU215921
11.	SVPP-Si 11	<i>Trichoderma asperellum</i>	KU215912
12.	SVPP-Si 12	<i>Trichoderma harzianum</i>	KU215922
13.	SVPP-Si 13	<i>Trichoderma asperellum</i>	KU215911
14.	SVPP-Si 14	<i>Trichoderma harzianum</i>	KU215923
15.	SVPP-Si 15	<i>Trichoderma asperellum</i>	KU215909
16.	SVPP-Si 16	<i>Trichoderma harzianum</i>	KU215924
17.	SVPP-Si 17	<i>Trichoderma asperellum</i>	KU215910
18.	SVPP-Si 18	<i>Trichoderma harzianum</i>	KU215925
19.	SVPP-Si 19	<i>Trichoderma lixii</i>	KU215927
20.	SVPP-Si 20	<i>Trichoderma harzianum</i>	KU215928

The flag leaf length of rice plants shows that highest leaf length was observed in isolates SVP Si 17 (39.34 %). The minimum increase percentage was observed in SVP Si 02 (07.62 %). All the remaining isolates showed least effect on root length and it was statistically at par with check. Likewise (Mishra and Salakhe, 2011) and (Doni *et al.*, 2014) also conducted the experiments to find out the effect of the various *Trichoderma* species on rice crop in which they found the effect on plant height (70.47 cm), tiller number (12), root length (22.5 cm) and root fresh weight (15.21 g) compared to the plants treated with other *Trichoderma* isolates tested was significantly higher than the control.

From Table 3, the isolates SVPP-Si 6 (32.96 %) was found to be highest in

increasing the fresh weight of the plant followed by SVPP-Si 09 (31.95 %), SVPP-Si 11 and 12 (31.11 %), SVPP-Si 03 (29.36 %) and SVPP-Si 05 (26.96 %). The lowest percent increase was found in SVPP-Si 04 (2.10 %). In all the isolates SVPP-Si 03 (35.00 %) was found to be highest in increasing (*i.e.* 0.94 g) the dry weight of the plant. The lowest percent increase was found in SVPP-Si 02 (08.80 %). All the native isolates significantly increase the fresh and dry weight of the plant. Many researchers like (Doni *et al.*, 2014) and have already discussed the capacity of *Trichoderma spp* to promote the growth and the vigour of the plant. (Saba *et al.*, 2012) have revealed that various isolates of *Trichoderma* which was T.12 and T.52 applied in substrate treatment increased aerial and root dry weight by 61.2 and 32.9%, respectively.

Table 2: Effect of different native strains of *Trichoderma* spp. on length of root, shoot and flag leaf of the plant growth of rice plant.

Treatment	length of shoot* (cm.)	Increase %	length of root* (cm.)	Increase %	length of flag* leaf (cm.)	Increase %
SVPP-Si 1	7.97 ± 0.06	30.00	18.43 ± 0.12	10.47	15.57 ± 0.12	29.97
SVPP-Si 2	7.17 ± 0.15	23.29	17.07 ± 0.12	03.33	11.80 ± 0.30	07.62
SVPP-Si 3	7.03 ± 0.06	21.76	19.37 ± 0.32	14.81	13.70 ± 0.20	20.43
SVPP-Si 4	8.07 ± 0.06	31.84	17.07 ± 0.60	03.33	13.17 ± 0.29	17.23
SVPP-Si 5	7.93 ± 0.06	30.64	18.07 ± 0.12	08.68	14.97 ± 0.06	27.18
SVPP-Si 6	9.43 ± 0.12	41.67	20.50 ± 0.44	19.51	17.17 ± 0.29	36.51
SVPP-Si 7	8.13 ± 0.06	32.34	17.43 ± 0.40	05.33	15.30 ± 0.17	28.75
SVPP-Si 8	7.77 ± 0.23	29.21	18.20 ± 0.35	09.34	14.43 ± 0.21	24.46
SVPP-Si 9	8.03 ± 0.06	31.50	18.50 ± 0.00	10.81	13.90 ± 0.36	21.58
SVPP-Si 10	9.87 ± 0.12	44.27	17.63 ± 0.23	06.40	14.60 ± 0.17	25.34
SVPP-Si 11	8.07 ± 0.06	31.84	19.90 ± 0.36	17.08	15.63 ± 0.15	32.39
SVPP-Si 12	7.47 ± 0.06	26.37	20.07 ± 0.12	17.78	13.17 ± 0.31	17.23
SVPP-Si 13	7.60 ± 0.00	27.63	17.17 ± 0.29	03.90	13.33 ± 0.06	18.22
SVPP-Si 14	7.03 ± 0.06	21.76	18.07 ± 0.12	08.39	14.37 ± 0.32	24.14
SVPP-Si 15	7.90 ± 0.10	30.37	19.43 ± 0.12	15.07	15.27 ± 0.29	28.61
SVPP-Si 16	8.07 ± 0.06	31.84	17.27 ± 0.31	04.47	14.80 ± 0.20	26.35
SVPP-Si 17	7.07 ± 0.06	22.20	19.37 ± 0.32	14.81	17.97 ± 0.81	39.34
SVPP-Si 18	7.27 ± 0.06	24.34	17.40 ± 0.35	05.17	15.83 ± 0.29	31.14
SVPP-Si 19	7.33 ± 0.15	24.96	20.00 ± 0.20	17.50	15.50 ± 0.40	29.67
SVPP-Si 20	7.97 ± 0.15	30.00	19.40 ± 0.17	14.94	17.40 ± 0.17	37.35
Control	5.50	-	16.50	-	10.90	-
C.D.	0.161	-	0.648	-	0.487	-

* mean of three replication, ± SD.

Table.3. Effect of different native strains of *Trichoderma* spp.on the fresh and dry weight of rice plant.

Treatment	Fresh weight of plant (gm.)	Increase %	Dry weight of plant(gm.)	Increase %
SVPP-Si 1	3.27 ± 0.40	14.67	0.74 ± 0.04	17.56
SVPP-Si 2	3.26 ± 0.13	14.41	0.67 ± 0.02	08.80
SVPP-Si 3	3.95 ± 0.15	29.36	0.94 ± 0.03	35.00
SVPP-Si 4	2.85 ± 0.08	02.10	0.70 ± 0.09	12.85
SVPP-Si 5	3.82 ± 0.08	26.96	0.84 ± 0.04	27.38
SVPP-Si 6	4.14 ± 0.06	32.96	0.90 ± 0.01	32.22
SVPP-Si 7	2.89 ± 0.07	03.46	0.71 ± 0.01	14.88
SVPP-Si 8	3.61 ± 0.51	22.71	0.72 ± 0.01	15.27
SVPP-Si 9	4.10 ± 0.09	31.95	0.90 ± 0.01	32.22
SVPP-Si 10	3.65 ± 0.06	23.56	0.74 ± 0.04	14.80
SVPP-Si 11	4.05 ± 0.12	31.11	0.85 ± 0.03	15.27
SVPP-Si 12	4.05 ± 0.06	31.11	0.87 ± 0.04	29.88
SVPP-Si 13	3.65 ± 0.06	23.56	0.76 ± 0.03	19.73
SVPP-Si 14	2.93 ± 0.03	04.77	0.68 ± 0.01	11.76
SVPP-Si 15	3.17 ± 0.15	04.98	0.79 ± 0.02	22.78
SVPP-Si 16	3.08 ± 0.12	09.41	0.67 ± 0.02	08.95
SVPP-Si 17	3.71 ± 0.12	24.29	0.74 ± 0.02	17.56
SVPP-Si 18	3.04 ± 0.12	08.23	0.78 ± 0.01	20.11
SVPP-Si 19	3.64 ± 0.24	23.35	0.83 ± 0.07	26.50
SVPP-Si 20	3.70 ± 0.02	24.59	0.81 ± 0.01	24.69
Control	2.79	-	0.611	-
C.D.	0.287	-	0.056	-

*Pot based study, ± Standard Deviation

Conclusion

The benefit of *Trichoderma* spp. in improving plant growth can be obtained through several mechanisms which include mycoparasitism, antibiosis, degradation of toxins, inactivation of pathogenic enzymatic pathways, resistance to pathogens, enhanced nutrient uptake, solubilization, sequestration of inorganic nutrients, and enhanced root hair development. In the present investigation effect on the flag leaf length of rice plants shows that highest leaf length was observed in isolates SVP Si 17 (39.34 %). In all the isolates SVPP-Si 6 (32.96 %) was found to be highest in increasing the fresh weight. In all the isolates SVPP-Si 03 (35.00 %) was found to be highest in increasing (*i.e.* 0.94 g) dry weight of the plant.

References

1. Doni, F., Al-Shorgani, N.K.N., Tibin, E.M.M., Abuelhassan, N.N., Anizan, I., CheRadziah, C.M.Z. and Wan Mohtar, W.Y. (2013). Microbial involvement in growth of paddy. *Current Research Journal of Biological Science*, 5(6): 285–290.
2. Doni, F., Anizan, I., CheRadziah, C.M.Z., Salman, A.H., Rodzihan, M.H., Wan Mohtar, W.Y. (2014). Enhancement of rice seed germination and vigour by *Trichoderma* spp. *Research Journal on Applied Science and Engineering Technology*, 7(21): 4547-4552.
3. Doni, F., Isahak, A., Zain, C.R.C.M. and Yusoff, W.M.W. (2014). Physiological and growth response of rice plants (*Oryza sativa* L.) to *Trichoderma* spp.

- inoculants. <http://www.amb-express.com/content/4/1/45>.
4. Gangwar, G.P. (2013). Growth promotion of rice seedlings by fungal and bacterial bio-agents effective against bacterial leaf blight of rice. *Journal of Applied and Natural Science*, 5(2): 430-434.
 5. Mishra, A. and Salokhe, V.M. (2011). Rice growth and physiological responses to SRI water management and implications for crop productivity. *Paddy Water Environment*, 9: 41–52. doi: 10.1007/s10333-010-0240-4.
 6. Nene, Y.L., Haware, M.P. and Reddy, M.V. (1981). Chickpea Diseases: Resistance Screening Techniques. Information Bulletins No. 10. ICRISAT, Patancheru, A.P., India, pp. 1-10
 7. Saba, H.D.V., Manisha, M., Prashant, K.S., Farham, H. and Tauseff, A. (2012). *Trichoderma* – a promising plant growth stimulator and Biocontrol agent. *Mycosphere*, doi:10.5943 / mycosphere / 3 /4/14.
 8. Times of India (2016). The Economic Times Agriculture. Internet source.