Study on the effect of *Trichoderma viride* on Phosphate solubilizing microorganisms in paddy cultivation with the combination of chemical fertilizer on soil fertility parameters

Abstract

Trichoderma viride, biological control with *Trichoderma viride* is an eco-friendly and has potential approach for managing plant diseases. It also aids in phosphate solubilization. Phosphate Solubilizing Microorganisms are ubiquitous, whose number varies from soil to soil. The present work on, ‘’Effect of *Trichoderma viride* on Phosphate Solubilizing Microorganism in Paddy cultivation” was conducted under lower gangetic alluvial region from 2016-2017(December to May) at Agricultural Experimental Station of Calcutta University,Baruipur,24 Parganas (South),West Bengal. The Rice variety “Satabdi (IET-4786)” from the department of Genetics and Plant Breeding was sown and recommended fertilizer dose of 80:40:40 kg per hectare. The experiment was carried out with six treatments replicated four times.Outofthesixtreatments,T3whichreceived T.V and P.S showed highest Carbon, Phosphorus and Potassium content and T6 showed highest Nitrogen content in the soil.

Keywords:Phosphate, trichoderma, gangetic, treatments, nitrogen.

Introduction

Phosphate-solubilizing bacteria have the ability to convert the insoluble phosphatic compounds into soluble forms in soil and make them available to the crops. In soil, phosphate-solubilizing bacteria constitute 1–50% and fungi 0.5%–0.1% of the total respective population. Generally, the phosphate-solubilizing bacteria outnumber phosphate-solubilizing fungi by 2–150 times (***Kucey,* 1983)**.Antagonistic biocontrol *Trichoderma viride* is one of the bioagents against several fungal pathogens which possess better ability to promote plant growth and soil remediation activity compared to their counterparts (virus, bacteria, nematodes and protozoa). These antagonistic fungi are most common among fungal biocontrol agents because of their multiple characteristics, namely antagonism and plant-growth stimulation. The excessive use of chemical fertilizers in the current decades has led to soil toxicity through the presence of toxic heavy metals and adversely affecting the health of rice plants (***Habibah et al.*,2011*)***. To overcome the decrease in soil fertility and deterioration in soil health caused by the use of

chemical fertilizers, it is necessary to look for alternative ways to improve soil fertility and stimulate the growth of rice plants.

Materials and Methods

The experiment was conducted during boro season for sowing (December) of Rice, "Satabdi (IET-4786)" an upland Rice under lower gangetic alluvial region from 2016-17 (December to May) at the agricultural experimental station of Calcutta University, Baruipur, 24 Parganas (south), West Bengal. RBD design was followed and the treatments, replications and randomization procedures were clearly defined and the analysis of variance method was followed to arrive at the conclusion by following (***Gomez and Gomez,*****1976**).Fertilizers N, P, K were applied in soil in the ratio 80:40:40 kg for 1 hectare. Average yield is 45-50 quintal/ha.

Results and Discussion

The pH of the treatments showed more acidic to neutral conditions due to the secretions of organic acids, toxins etc resulting in lowering of the pH. The sequence observed was T6<T2<T4<T3<T1<T5<C (Table 1). The secretions of the phosphate solubilising microorganisms made the soil acidic *i.e* slightly acidic in this experiment and more suitable for Paddy cultivation and increasing the uptake of macro and micronutrients.The Carbon content of the soil is increased with the application of the inoculants. The application of the bioagents also influences the carbon content in the soil. *Trichoderma viride* shows potential in increasing carbon contents. The sequence of availability of carbon is<T6C<T2<T5<T4<T1<T3. Moisture content of the soil shows an increase in each treatment. The increment in moisture content due to the various factors and the added inoculants varies and there is maximum moisture increase with *Trichoderma viride*(T1) followed by *Trichoderma viride*+ *Pseudomonas striata*(T3) and least moisture content in Control. The sequence of moisture content increases as T2<T6<T4<T5< T3 <T1<C.

Table 1. Physico-chemical properties of the soil under different treatments:

	Treatments	pH	ORGANIC CARBON (g/kg)	MOISTURE CONTENT(%)	AVAILABLE PHOSPHORUS (kg/ha)	POTASSIUM (kg/ha)	TOTAL NIROGEN (g/Kg)

C	Control	6.5	14.01	45	11.80	115	0.10
T1	*Trichoderma viride*(T.V)	6.0	15.50	54	28.13	133.34	0.27
T2	*Azotobacterchroococcum*(A.C)+*T richoderma viride*(T.V)	5.4	14.40	46	21.34	163.34	0.83
T3	*Pseudomonas striata* (P.S) + *Trichoderma viride*(T.V)	5.6	15.70	53	35.13	230	0.57
T4	*Azotobacterchroococcum*(A.C)+*P seudomonas striata* (P.S) + *Trichoderma viride*(T.V).S)	5.5	15.10	49	32.33	201	0.93
T5	*Azotobacter chroococcum*(A.C)	6.2	14.83	51	19.27	219	1.07
T6	*Azotobacterchroococcum*(A.C) + *Pseudomonas striata* (P.S)	5.0	12.70	48	13.45	240	1.13
	MEAN	5.74	14.61	49.43	23.06	185.95	0.7
	RANGE	5-6.5	12.70-15.70	45-53	11.80-35.13	115-240	0.10-1.13
	CD(5% Level of significance)	0.35	0.56	5.15	4.06	86.79	0.48
	Standard Deviation	0.52	1.03	3.41	9.07	49.15	0.4
	INITIAL	6.8	13	44	10.098	110	0.11

The Phosphorus content shows a huge increase from the control plot. The added micro-organisms shows phosphate solubilising activity. *Pseudomonas striata* is Phosphate solubilising bacteria that have made Phosphorus in available form by secreting organic acids, *Azotobacter chroococcum* is a Nitrogen fixing bacteria but it also helps in Phosphate solubilization and *Trichoderma viride* is a Phosphate solubilising fungi that also have an antagonistic properties to pathogens .The presence of the microorganisms have converted Phosphorus to its available form by Phosphate solubilization. The sequence for Phosphorus availability is T3>T4 >T1>T2 >T5>C.The value recorded shows medium to high value of Phosphorus in the soil. Potassium content of the soil from the result shows a medium value *i.e* it ranges between 115-240 Kg/ha. The combined application of three nutrients has resulted in more availability of potassium. There is an increase as compared to control and the bioagent also contributed to availability of macro and micronutrients.The sequences of Potassium content in the soilis T6> T3> T5>T4 >T2 >T1>C. Nitrogen Availability is increased with *Azotobacter chroococcum*added in the

soil.Thetreatment with *Azotobacte*r shows highest Nitrogen contents. The sequence of nutrient availability is T6 >T5>T4>T2 >T3>T1.The presence of *Azotobacter* in the soil increases Nitrogen content but in treatment 6 there is less nitrogen in the soil even with *Azotobacte*r as *Trichoderma viride*can forms an antagonistic relationship with *Azotobacter chroococcum.*The other two microorganisms enhance the availability of nitrogen in the soil. Similar observations were reported earlier by ***Mukherjee and Rai*(2000),** ***Rudresh et al.,*** **(2005**) and ***Resende et al.*(2014**).

Conclusion

The treatment T3 showed the highest organic carbon which received P.S and T.V as inoculums and organic manure Vermicompost @ 10 tonnes per ha. The total nitrogen content of the soil under different treatments is maximum in T6 which received A.C.*Azotobactor* helps in nitrogen fixation and increases the total nitrogen of the soil. The Available phosphorusin T3due to the activity of phosphate solubilising microorganisms by converting unavailable phosphorus to available form andPotassium was highest in T6.

References

Gomez, K. A.(1976).Statistical procedure for agriculture research with emphasis on Rice.*International Rice Research Institute.*630: 72-83.

Habibah, J., Lee, P.T., Khairiah, J., Ahmad, M.R, Fouzi, B.A. and Ismail, B.S. (2011). Speciation of heavy metals in paddy soils from selected areas in Kedah and Penang, Malaysia. *African J Biotechnol.* 10(62):13505–13513.

Kucey,R.M.N. (1983). Phosphate-solubilizing bacteria and fungi in various cultivated and virgin Alberta soil. *Canadian journal of Soil Science.* 63: 671-677.

Mukherjee, P. K. and Rai, R.K. (2000). Effect of vesicular arbuscular mycorrhizae and phosphate solubilizingbacteria on growth, yield and phosphorus uptake by wheat (*Triticum aestivum*) and chickpea (*Cicerarietinum).Indian J. Agron.* 45:602–607.

Resende,M.R., Jakoby, I. C. M. C., Santos, L. C. R. D., Soares, M. A., Pereira, F. D.,Souchie,E.L. and Sulva,F. G.(2014). Phosphate solubilization and phytohormone production by endophytic and rhizosphere Trichoderma isolates of Guanandi(*Calophyllumbrasiliensecambess*). *African journal of Microbiology research.*8(27): 2616-2623.

Rudresh,D.L.,Shivaprakash,M.K and Prasad,R.D.(2005). Tricalcium phosphate solubilising abilities of *Trichoderma*spp. in relation to phosphorus uptake,growth and yield parameters of Chickpea(*Cicer arietinum L.*). *Canadian journal of Microbiology*.51:217-222.