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Effect of Biofertilizers on the Growth and Development of Mung Plant under Normal and Salt Stressed Conditions

Dr. Rabia Badar
Associate Professor, Department of Botany, Jinnah University for Women, Nazimabad, Karachi, Pakistan
Iqra Aslam
MSc. Student Department of Botany, Jinnah University for Women, Nazimabad, Karachi, Pakistan
Asif Ilyas
MS Student, Department of Economics, University of Peshawar, Pakistan

Abstract
The given research evaluates the effect of biofertilizers on the growth and development of Mung plants (Vigna radiata). The biofertilizers was given to the plants as compost. Four different types of Trichoderma sp. were composted using Wheat bran as a carbon source @ 10 tons per hectare. The result showed that, Living forms of microorganisms induced an overall higher increase in growth and developments of plants. Salinity treatments also reduced all growth parameters as compared to control untreated plant. Whereas, the application of Trichoderma overcomes the inhibitory effect of salt on plant growth. Trichoderma spp. promoted the root growth and shoot growth of the mung plants as compared to the untreated plants. The promotion in length of the studied plant was significant with the application of living biofertilizers alone and along with low concentration of salinity (i.e.0.2 % NaCl).

Key words: *Mung plants, biofertilizers, Trichoderma, salinity, compost*

1. Introduction

Agriculture is the foundation of Pakistan's affluence. Sustainable productivity in our agricultural ecosystems is a major objective. Sustainable agriculture depends on a whole-system approach whose overall objective is the lifelong health of the land and the community (Brodt, et al. 2011).

There are a number of vital limitations of sustainable farming and causing low yield (Parikh & James, 2012). They comprise soil humiliation (alkalinity, soil salinity, corrosion and soil fertility reduction), decline of water resources, unprofessional ways of irrigation methods and the allotment of the land holdings and deprived farming practices. Land has key importance for farming production. More or less all types of soils have water soluble salts. Vital nutrients in the soluble form are taken up through the plants, although these salts in too much amount, i.e., Salt stress, stifle plant development. Soil scarcity due to Stalinization is promising as an alarming hazard to sustainable agriculture. The effects of salinity are disturbing in arid and semi arid environments (Azhar *et al*., 2007).

The crop yields are condensed so severely at elevated salt levels (Steppuhn, 2013) and crop farming is not reasonable with any soil amendments. Osmotic potential of water is lowered by addition of salts, resulting in decreased availability of water to the roots and therefore exposes plants to secondary osmotic stress. This implies that all the physiological responses linked with the drought stress can also be invoked by salt stress (Barus et al., 2013**)**. The condition is still more threatening in developing countries, such as Pakistan. Place of Pakistan falls in the region with semi-arid to arid type of climate *(Qamar-uz-Zaman and G. Rasul, 2003-2004).*

Some of the microorganisms, mostly important bacteria and fungi can increase plant performance under stress condition and, consequently, get better yield (Evelin *et al*., 2009)

At high salinity point, it was found that treatments supplied by biofertilization with yeast decreased the unpleasant outcome of salinity (Moradi *et al*., 2011).

Trichoderma spp are fungi frequently present in soils, on plant roots. Some genes of Trichoderma species can be used to give resistance to the biotic and abiotic stresses such as salt, heat and drought (Kuc J, 2001). Some *Trichoderma* rhizosphere-competent strains that can colonize root surfaces have been shown to have direct effects on plants, escalating their growth potential and nutrient uptake, fertilizer efficiency consumption, proportion and rate of seed germination, and induced systemic resistance (ISR) to diseases

(Shoresh *et al*, 2010). Different degrees of salinity were established to have a different impact on the worth of the diverse antagonistic modes of action of *T. harzianum* in controlling *Verticillium* wilt in tomato (Regragui and Lahlou, 2005; Gal-Hemed *et al.*, 2011).

2. Materials and Method

2.1. Collection and Isolation of fungi Samples:

Fungi was collected from different localities of Karachi and isolated from root samples of plants on potato dextrose agar that also contained antibiotics *viz.*, penicillin (100,000unit/liter) and streptomycin (0.2g/liter). Identified test fungus and test fugal pathogens were made separated, isolated on PDA slants for further use. Microbial inoculation was prepared by shaking 50ml of PDA (potato dextrose agar) broth with $1cm^2$ of Trichoderma separately for each fungal species. The microbial mixture was use for composting of wheat bran.

2.2. Experimental Procedure

Experimental treatments were divided into three groups. Each treatment had three replicates. First set contained compost material. Second set was given 0.2% NaCl solution along with the compost. Third group had 0.5% NaCl solution with the compost. Compost was added to the soil in a ratio of 10 ton/ha. After 30 days plants were plugged out. Analyzed for their physical and biochemical parameters. In biochemical parameters total protein and total carbohydrate was determined by using Lowry's 1951 and Yemm and Willis, 1954 method respectively. Total phosphorous was estimated by Ashraf *et al*, 1974 method.

3. Result and Discussion

Trichoderma spp. showed positive results on root length with JUF2L showing a maximum promotion of 27% over the control (Fig.1). Trichoderma spp. with salt solutions of conc. 0.2% and 0.5% also had positive effects over control. Similarly, Windham *et al.,* (1985**)** reported that T. harzianum and T. koningii produced a growth regulating factor that increased the rate of seed germination and mass of shoot (Karnataka, 2009). At 0.2% salt concentration, positive effect decreased (14%) as compared to single Trichoderma sp. treatment, while at 0.5% salt, the percent value of root length increased. Rawat *et al*., 2011 also reported that when Trichoderma spp. was given in saline conditions, the fungus has been reported to decrease the negative impact of salinity on plant growth. Similarly, he observed that Trichoderma strains in plants increases root length, which helps in additional water achievement and in that way increasing the plants ability to resist abiotic stresses (drought, salt etc) and uptake of nutrients**.**

The shoot length showed a positive effect after the application of Trichoderma spp. over control. The maximum increment was of 29% over control. Trichoderma species have been effective in increasing shoot length in plants. The shoot length was the highest in the pots inoculated with T. viride followed by control (Karnataka, 2009). Trichoderma spp. with salinity treatment of 0.2% and 0.5% showed less shoot lengths than the shoot length increase of plants treated with Trichoderma spp. only (Fig no.2). For both salt concentrations, JUF3 gave maximum promotion.

Table 2 showed that, Plants with Trichoderma treatments showed an increase in the carbohydrate production over control. Maximum result was given by fungal species JUF5; there were significantly increases the carbohydrate content of soybean was also reported by H. O. Egberongbe *et al*., (2010) with the application of Trichoderma sp.

Trichoderma spp. with salinity treatment of 0.2% and 0.5% showed positive effects of 91% with JUF5 and 82% with JUF2 respectively on carbohydrate content over control. Although this increment was much less than that of the shoot carbohydrate production of plants treated with Trichoderma spp. only.

Trichoderma spp. caused an increment of up to 141% over the control on protein content. Similar finding was also observed by Akladious *et al*., (2012). He reported that the total protein content in both roots and shoots were high in plants grown from seeds treated with the metabolic

solution of T. harzianum earlier to sowing than that of plants grown in soil inoculated with T. harzianum, whereas, the increment for protein content of plants treated with Trichoderma spp. and salt solutions in the concentration of 0.2% and 0.5% was 102% by JUF5 and 151% by JUF2 respectively. This may be due to the reason that Trichoderma spp. discharges a range of compounds that stimulate resistance in response to biotic and abiotic stresses (Harman *et al*., 2004)

Trichoderma treatment caused an increase in the plant phosphorous content over control. Fungal species JUF3 showed the highest increment of 250% (Tab.2). Yedidia *et al.,* (2001) reported that Trichoderma spp. increases the uptake and concentration of a mixture of nutrients (copper, phosphorus, iron, manganese and sodium) in roots in hydroponic culture, even under axenic conditions. While, when salt concentration of 0.2% and 0.5% was given along with the Trichoderma spp., promotion in Phosphorus content was observed. Different scientists, (Altomare *et al*., 1999; G. E. Harman *et al*, 2004) have reported that the increase in Phosphorous content for salinity treated plants was observed to be much higher than without salinity treatment.

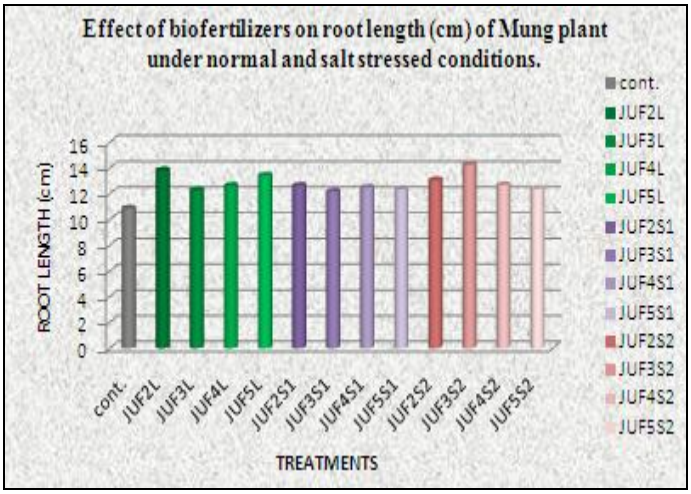

Figure 1

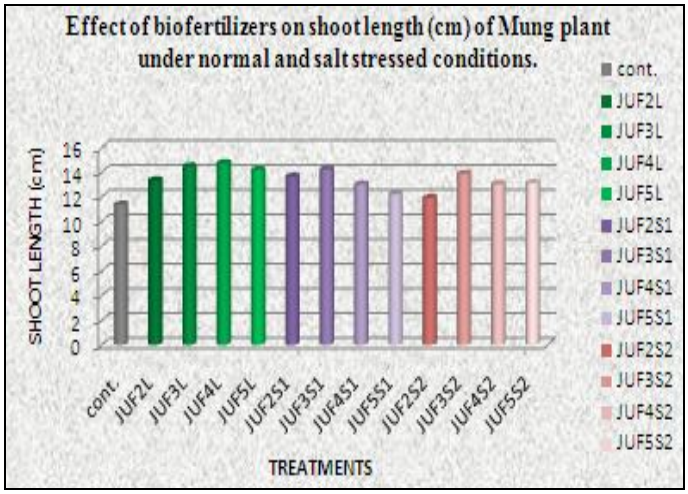

Figure 2

Sl. No.	TREATMENTS	Code no.
1	Untreated	Control
2	Trichoderma sp.1	JUF2L
3	Trichoderma sp.2	JUF3L
4	Trichoderma sp.3	JUF4L
5	Trichoderma sp.4	JUF5L
6	Trichoderma sp.1 + 0.2 % salt	JUF2S1
7	Trichoderma sp.2 + 0.2 % salt	JUF3S1
8	Trichoderma sp.3 + 0.2 % salt	JUF4S1
9	Trichoderma sp.4 + 0.2 % salt	JUF5S1
10	Trichoderma sp.1 + 0.5 % salt	JUF2S2
11	Trichoderma sp.2 + 0.5 % salt	JUF3S2
12	Trichoderma sp.3 + 0.5 % salt	JUF4S2
13	Trichoderma sp.4 + 0.5 % salt	JUF5S2

Table 1: List of treatments and their code nos

TREATMENTS	CARBOHYDRATE (µmole/gm)	PROTEIN (µmole/gm)	PHOSPHOROUS (%)
Control	1.90^{l} ±0.18 (0)	1.12^{k} ±0.38 (0)	0.08^{f} ±0.05 (0)
JUF2L	2.93^{j} ±1.09 (+54.21)	2.02^{e} ±0.69 (+80.35)	0.27^{c} ±0.08 (+237.5)
JUF3L	3.11^{h} ±0.53 (+63.68)	2.03^{e} ±0.61 (+81.25)	0.28^{c} ±0.20 (+250)
JUF4L	3.10^{h} ±1.08 (+63.15)	2.70^{b} ±1.06 (+141.07)	0.21^{d} ±0.05 (+162.5)
JUF5L	5.24^{a} ±2.54 (+175.78)	2.14^{d} ±0.55 (+91.07)	0.21^{d} ±0.04 (+162.5)
JUF2S1	3.39^{g} ±1.68 (+78.42)	1.49^{j} ±0.32 (+33.03)	0.15^{e} ±0.06 (+87.5)
JUF3S1	3.14^{h} ±0.95 (+65.26)	1.65^{i} ±0.46 (+47.32)	0.46^{a} ±0.17 (+475)
JUF4S1	3.02^{i} ±1.40 (+58.94)	2.01^{e} ±1.22 (+79.46)	0.13^{e} ±0.03 (+62.5)
JUF5S1	3.63^{e} ±0.29 (+91.05)	2.27^{c} ±1.09 (+102.67)	0.37^{b} ±0.36 (+362)
JUF2S2	3.46^{f} ±0.12 (+82.10)	2.82^{a} ±0.76 (+151.78)	0.16^{d} ±0.14 (+100)
JUF3S2	3.05^{i} ±0.54 (+60.52)	2.65^{b} ±2.17 (+136.60)	0.35^{b} ±0.25 (+56.25)
JUF4S2	2.72^{k} ±1.46 (+43.15)	1.74^{h} ±1.19 (+55.35)	0.48^{a} ±0.40 (+500)
JUF5S2	2.35^{g} ±0.76 (+23.68)	2.17^{d} ±0.83 (+93.75)	0.32^{b} ±0.18 (+300)

Table 2: Effect of biofertilizers on biochemical parameters of Mung plant under normal and salt stressed conditions. Value in parenthesis showed percent increase and decrease (+/-) over control. Values with ± showed standard deviation of mean.

4. References

1. Akbar M. and Ponnamperuma FN (1982) Saline soils of South and South East Asia as potential rice lands, Rice research strategies for the future. IRRI. Manila. Philip. Pp265-281.
2. Akladious and Abbas (2012) Application of Trichoderma harziunum T22 as a biofertilizer supporting maize growth, African Journal of Biotechnology Vol. 11(35), pp. 8672-8683.
3. Altomare C., Norvell W A., Björkman T. & Harman, GE (1999) Solubilization of phosphates and micronutrients by the plant-growth-promoting and biocontrol fungus Trichoderma harzianum Rifai 1295-22, Appl. Environ. Microbiol. 65, 2926–2933.
4. Ashraf MY, Khan AH, Azmi AR (1992) Cell membrane stability and its relation with some physiological processes in wheat. Acta Agron Hung. 41(3-4): 183-191.
5. Azhar FM, Khan AA and Saleem N (2007) Genetic mechanism controlling salt tolerance in Gossypium hirsutum L. seedlings, Pakistan J. Bot., 39: 115–121.

6. Barus WA, Rauf A, Damanik SJB, Rosmayati (2013) Screening and Adaptation in Some Varieties of Rice under Salinity Stress (Case Study at Paluh Merbau, Deli Serdang District, North Sumatera, Indonesia). J Rice Res 1: 112. doi: 10.4172/jrr.1000112 (1-4).
7. Brodt S, Six J, Feenstra G, Ingels C& Campbell D (2011) Sustainable Agriculture. Nature Education Knowledge 3(10):1.
8. El-Shanshoury AR (1991) Biosynthesis of indole-3- acetic acid in Streptomyces atroolivaceus and its changes during spore germination and mycelial growth, Microbios 67:159-164.
9. Evelin H, Kapoor R and Giri B (2009) Arbuscular mycorrhizal fungi in alleviation of salt stress, J. Ann. Bot., 104(7): 1263-1280.
10. Gal-Hemed I, Atanasova L, Komon-Zelazowska M, Druzhinina IS , Viterbo A and Yarden O (2011) Marine Isolates of Trichoderma spp. as Potential Halotolerant Agents of Biological Control for Arid-Zone Agriculture, Appl Environ Microbiol. 2011 August; 77(15): 5100–5109. doi: 10.1128/AEM.00541-11
11. Gao KX, Liu XG, Liu YH, Zhu TB and Wang SL (2002) Potential of Trichoderma harzianum and T. atroviride to control Botryosphaeria berengeriana f. sp. piricola, the cause of apple ring rot. J Phytopathol., 150, 271-276.
12. Grondona I, Hermosa MR, Tejada M, Gomis MD, Mateos PF,Bridge PD, Monte E, Garcia- Acha I (1997) Physiological and biochemical characterization of Trichoderma harzianum, a biocontrol agent against soil borne fungal plant pathogens. Appl. Environ. Microbiol 63:3189-3198.
13. Egberongbe HO, Akintokun AK, Babalola OO and Bankole MO (2009) The effect of Glomus mosseae and Trichoderma harzianum on proximate analysis of soybean (Glycine max (L.) Merrill.) Seed grown in sterilized and unsterilized soil, journal of Agricultural Extension and Rural Development Vol. 2(4), pp. 54-58.
14. Harman GE, Howell CR, Viterbo A, Chet I, Lorito M, (2004). Trichoderma species-Opportunistic, avirulent plant symbionts, Nat. Rev. Microbiol. 1: 43-56.
15. Karnataka (2009) Seed germinability, root and shoot length and vigour index of soybean as influenced by rhizosphere fungi J. Agric. Sci., 22 (5) (1120-1122).
16. Kuc J (2001) Concepts and direction of induced systemic resistance in plants and its application, Eur. J. Plant Pathol. 107: 7-12.
17. Lowry OH, Rosebrough NJ, Farr AL and Randall RJ (1951) J.Biol.Chem 193: 265.
18. Moradi A, Tahmourespour A, Hoodaji M and Khorsandi F (2011) Effect of salinity on free living - diazotroph and total bacterial populations of two saline soils, African Journal of Microbiology Res. Vol. 5(2) pp. 144-148.
19. Munns R and Termaat A (1986) Whole plant responses to salinity, Aust. J. Plant Physiol. 13:143–160.
20. Parikh SJ & James BR (2012) Soil: The Foundation of Agriculture. Nature Education Knowledge 3(10):2.
21. Qamar-uz-Zaman Chaudhry and Rasul G (2003, 2004) Quarterly SCIENCE VISION Vol.9 No.1-2 (Jul - Dec, 2003) & 3-4 (Jan - Jun, 2004).
22. Rawat L, Singh Y, Shukla N, Kumar J (2011) Alleviation of the adverse effects of salinity Stress in wheat (Triticum aestivum L.) by seed biopriming with salinity tolerant isolates of Trichoderma harzianum. Plant soil, DOI: 10.1007/s11104-011-0858-z.
23. Regragui A and Lahlou H (2005) Effect of salinity on in vitro Trichoderma harzianum antagonism against Verticillium dahlia, Pak. J. Biol. Sci. 8:872–876.
24. Shoresh M, Mastouri F, Harman GE (2010) Induced Systemic Resistance and Plant Responses to Fungal Biocontrol Agents, Annual Review of Phytopathology Vol. 48: 21-43.
25. Steppuhn H (2013) Sustainable production of crops grown in saline root zones.The Canadian Society for Bioengineering. Paper No.CSBE13-19.
26. Villa-Castorena M, Ulery AL, Catalán-Valencia EA, and Remmenga M (2003) Salinity and nitrogen rate effects on the growth and yield of Chile pepper plants, Soil Science Society of American Journal. 67:1781-1789.
27. Windham M T, Elad Y and Baker R (1985) A mechanism for increased plant growth induced by Trichoderma sp. Phytopath., 75:518-521.
28. Yedidia I, Srivastva A K, Kapulnik Y & Chet I (2001) Effect of Trichoderma harzianum on microelement concentrations and increased growth of cucumber plants, Plant Soil 235, 235–242.
29. Yemm EW, Willis AJ (1956) The estimation of carbohydrate in the plant extract by anthrone reagent, Journal of Biological Chemistry. 57: 508-514.
30. Saharan V, Nehra (2009) Plant Growth Promoting Rhizobacteria: A Critical Review BS, Life Sciences and Medicine Research, LSMR-211