International Journal of Applied Sciences and Biotechnology ISSN 2091-2609

OPEN ACCESS

Available online at www.ijasbt.org

International Journal of Applied Sciences and Biotechnology

A Rapid Publishing Journal

APPLIED SCIENCES		BIOTECHNOLOGY
Biochemistry	Immunobiology	Microbial biotechnology
Molecular biology	Bioinformatics	Medical biotechnology
Microbiology	Novel drug delivery system	Industrial biotechnology
Cell biology	Pharmacology	Environmental biotechnology
Cytology	Neurobiology	Nanotechnology
Genetics	Bio-physics	
Pathology	Botany	
Medicinal chemistry	Zoology	
Polymer sciences	Allied science	
Analytical chemistry	Earth science	
Natural chemistry		

If any queries or feedback, then don't hesitate to mail us at:
editor.ijasbt@gmail.com

SEM-Biotech Publishing

IC Value: **4.37**

S.R. Adhikari et al. (2013) Int J Appl Sci Biotechnol, Vol 1(4): 184-188
DOI: 10.3126/.ijasbt.v1i4. 9134

Research Article

International Journal of Applied Sciences and Biotechnology

ISSN: 2091-2609

EFFECT OF MICROBIAL (*Jeevatu*™) TREATMENT ON RICE (*Oryza sativa* L.) PRODUCTION

Suraj Raj Adhikari[1]*, Khadga Bhakta Paudel[2], Kusum Pokhrel[1], Amrita Paudel[2]

[1]Paluwa Nepal, Kaski
[2]Nepalese Farming Institute, Kathmandu

*Corresponding author email: adhikarisr@gmail.com

Abstract

Jeevatu™ is a consortium of beneficial natural microbes, available in liquid form. The rice yield was increased vigorously high in *Jeevatu* based rice cultivated plant. The seed production in per spikelet is 237.1 ± 44.92 in *Jeevatu* based and 179.4 ± 25.26 in chemical based rice plant. In case of vegetative growth, 173.1 ± 6.34 cm and 140.9 ± 11.11 cm in *Jeevatu* based rice plant and chemical based methods respectively. Similarly the length of stalk of spikelet is 27 ± 1.63cm and 22.1 ± 2.23 cm was observed in *Jeevatu* based and chemical based respectively. The number of stalk in lumps is 16.2 ± 1.75 and 12.2 ± 2.20 in *Jeevatu* and chemical based paddy plant respectively under the same environment and physical factors.

Keywords: *Jeevatu,* beneficial microbes, *Oryza sativa* , organic liquid manure, rice yield.

Introduction

Nepalese Farming Institute (NFI), a non-profiteering agricultural research and development organization, has developed a consortium of natural beneficial microbes called *Jeevatu. Jeevatu* is non-poisonous, neither genetically modified organism (GMOs) nor derived from GMOs. *Jeevatu* has been proven to manage a diverse range of soil and plant nutrition and plant protection problems (all crops-cereals, pulses, fruits, vegetables, spice and medicinal plants) in different agro-ecological zones ranging from 60 meter above sea level to 3200 meter above sea level. Soil-plant-microbes interaction has got high importance in recent decades. Beneficial microbes are highly significant in different crop variety. These help in various ways such as Nitrogen fixation; Solubilization of inorganic nutrients; Production of antibiotics, vitamins, hormones, amino acids, organic acids, alcohols and various biogenic and bioactive substances through secondary metabolism; Decomposition of organic wastes and residues; Suppression of soil-borne pathogens; Recycling and increased availability of plant nutrients; Degradation of toxicants including pesticides; Production of simple organic molecules for plant uptake.

The key ingredients of *Jeevatu*™ are: *Yeast, Trichoderma spp, Penicillium spp, Aspergillus, Azotobacter spp, Lactobacillus spp, Bacillus spp, Pseudomonas spp* and *Proteus spp*.

Nitrogen-fixing bacteria to develop biofertilizer for crops like wheat, rice, etc. are very essential. Biological nitrogen fixation is an inexpensive source of nitrogen for higher yields in non leguminous crop, *e.g.* rice and wheat farming systems (Akond *et al*., 2007). *Azotobacter* is the genus consisting aerobic, free-living, nitrogen-fixing bacteria that are found throughout the world (Becking *et al.,*1981; Tchan *et al*.,1984). In fact, field trials have demonstrated that under certain environmental conditions, inoculation with *Azotobacter* has beneficial effects on plant yields due to the increase of fixed nitrogen content in soil (Maltseva *et al.,* 1995; Mrkovacki *et al*., 1996) and to the microbial secretion of stimulating hormones, like gibberellins, auxins and cytokinins (Martinez *et al.,* 1989; Mishra *et al*., 1995). Several authors have shown the beneficial effects of *Azotobacter chroococcum* on vegetative growth and yields of maize and rice (Pandet *et al*., 1998; Elshanshoury A R, 1995) as well as the positive effect of inoculation with this bacterium on wheat (Garg *et al.,* 2001).

Phosphate solubilizing bacteria (PSB) are used as biofertilizer since 1950's (Krasilinikov NA, 1957; Kudashev IS, 1956). These microorganisms secrete different types of organic acids e.g., carboxylic acid (Deubel & Merbach, 2005) thus lowering the pH in the rhizosphere (He & Zhu, 1988) and consequently dissociate the bound forms of phosphate like $Ca_3(PO_4)_2$ in calcareous soils. Phosphorus biofertilizers could help increase the availability of accumulated phosphate (by solubilization), efficiency of biological nitrogen fixation and increase the availability of Fe, Zn etc., through production of plant growth promoting substances (Kucey *et al*., 1989). Trials with PSB indicated yield increases in rice (Tiwari *et al.,* 1989), maize (Pal, 1999) and other cereals (Ozturk *et al*., 2003).

Potassium mobilizing bacteria as bio fertilizers was suggested as a sustainable solution to improve plant nutrient and production (Vessey JK, 2003). Increasing the bioavailability of P and K in soils with inoculation of plant growth promoting rhizobacteria (PGPR) or with combined inoculation and rock materials, which may lead to increasing P uptake and plant growth, was reported by many researchers (Lin *et al.,* 2002; Sahin *et al.,* 2004; Girgis MGZ, 2006 and Eweda *et al*., 2007).

Trichoderma genus are strains of *T. viride* and *T. harzianum,* which is a species aggregate that includes different strains used as Biological control agent (BCAs) of phytopathogenic and viral vector fungi (Grondona *et al*.,1997). *Trichoderma* BCAs control ascomycetous, deuteromycetous and basidiomycetous fungi, which are mainly soil-borne but also airborne pathogens (Chet *et al.,*1997). *Trichoderma* is more efficient in acidic than alkaline soils. *Trichoderma* strains grow rapidly when inoculated in the soil, because they are naturally resistant to many toxic compounds, including herbicides, fungicides and pesticides such as DDT, and phenolic compounds (Monte E., 2001). *Trichoderma* strains are very efficient in controlling several phytopathogens, such as *R. solani*, *P. ultimum* or *Sclerotium rolfsii*, when alternated with methyl bromide, benomyl, captan or other chemicals (Vyas *et al*.,1995).

Lactic acid bacteria have also been used for treatment of cattle manures and sewage for odor abatement, and as inoculants to accelerate composting of organic wastes (Okada S, 1988). The lactic acid bacteria inoculated in to the soil amended with different organic materials as substrates, could provide a more effective means for recycling plant nutrients and for increasing soil humus formation.

Materials and Methods

Jeevatu is a package of mixed culture of beneficial microbes which are collected from natural condition and developed from Nepalese Farming Institute (NFI). The key ingredients of *Jeevatu*™ are : *Yeast, Trichoderma spp, Penicillium* spp, *Aspergillus* spp, *Azotobacter* spp, *Lactobacillus* spp, *Bacillus* spp, *Pseudomonas* spp, *Proteus* spp.

Techniques for preparation of *Jeevatu* based organic liquid manure I: First of all, a white plastic piece of 1.25 meter long and 500 gauze was taken and made it airtight to one side of the plastic sheet. An open sunny place was chosen to make a circular pit of depth 1 feet and 2 feet in diameter. The pit should be smoothening by raw cattle manure to maintain the temperature and maintain the uniformity inside the pit. Then, the plastic piece was put in that circular pit. Inside that plastic bag 25 Kg of cow dung (well decomposed, fine compost) was kept. Then, 1 liter of *Jeevatu* was poured and mixed it thoroughly with the cow dung. A mixture of 25 liter of cattle urine and 25 liter of water was poured (if cattle urine is not available then 50 liter of water) in the plastic bag and made it air tight. Then, the bag was opened and the cow dung and water was mixed thoroughly; thrice a week. Depending upon the temperature organic liquid manure will be ready to use after the second or third week. The indicators for the prepared organic liquid manure 1 are greenish growth inside the plastic and an absence of off flavor of cow dung.

Techniques for preparation of *Jeevatu* based organic liquid manure 2: The same steps were repeated up to putting the plastic in the circular pit. Then, 37.5 litter of cow urine was kept inside the plastic bag and 1 liter of *Jeevatu* was mixed thoroughly. Then, it was made airtight after adding 37.5 liter of water in the plastic bag. In this technique also, the bag was opened and cow urine and water was mixed thoroughly; thrice a week. Depending upon the temperature organic liquid manure will be ready to use after the second or third week. The indicators for the prepared organic liquid manure 2 are greenish growth inside the plastic and an absence of off flavor of cow dung.

Techniques to use organic liquid manure 1: 1 liter of organic liquid manure and 4-5 liter of water was mixed. This solution was applied as drenching for rice plant nutrition and management of soil borne pest problems as a prophylactic application; once a week.

Techniques to use organic liquid manure 2: Similarly, 1 liter of organic liquid manure 2 and 3 liter of water was mixed properly. This solution was sprayed on plant; once a week, before flowering (10 am to 3 pm).

Result and Discussion

Effect of *Jeevatu* on vegetative growth of Paddy: Vegetative growth in rice plant was observed at harvesting period with control reference basic chemical treatment method. The height of the paddy plant in *Jeevatu* based was 173.1±6.34 cm but in the chemical based method was only 140.9±11.11 cm. Similarly the length of stalk of spikelet was observed to be; 27±1.63cm and 22.1±2.23 cm in *Jeevatu* based and chemical based respectively. The number of stalk in lumps was 16.2±1.75 and 12.2±2.20 in *Jeevatu* and chemical based paddy plant respectively under the same environment and physical factors.

Effect of Jeevatu on rice production: The yield production of rice was observed at harvesting time period the non fruiting stalk value in *Jeevatu* based plant was 0.5± 0.7 and in control (chemical based) plant was 0.7±0.82. The mean seed production per spikelet is 237.1±44.92 and 179.4±25.26 in *Jeevatu* based and chemical based cultivated rice plant respectively. This result shows that, *Jeevatu* based plant produce 58 seeds per plant more than that of chemical based plant. The same result was obtained in trials with beneficial microbes in case of rice, maize and other cereals (Tiwari *et al.,* 1989; Pal, 1999; Ozturk *et al*., 2003). Dry weight of the 10000 seeds was 244.998 gm in Jeevatu based plant where as dry weight of 10000 seeds were 225.000 gm in chemical based plant. From this result, it was found that 19.998 gm of dry weight per 10000 seeds was increase in *Jeevatu* based in comparison to chemical based.

Table 1: comparative production of Rice in *Jeevatu* based and chemical based cultivation.

S.N.	Replication	Height of plant (cm)		Length of stalk of spikelet (cm)		In one lump of paddy plants contains no of stalk	
		Jeevatu Based	Chemical Based	Jeevatu Based	Chemical Based	Jeevatu Based	Chemical Based
1	a	176	144	27	23	13	11
2	b	168	138	29	24	18	13
3	c	172	152	25	22	16	14
4	d	180	127	27	18	17	14
5	e	178	148	24	23	18	10
6	f	162	138	26	21	14	16
7	g	175	118	28	25	15	12
8	h	165	143	29	22	16	13
9	i	174	152	28	24	18	9
10	j	181	149	27	19	17	10
	Mean	173.1±6.34	140.9±11.11	27±1.63	22.1±2.23	16.2 ± 1.75 stalk/lump	12.2 ±2.20 stalk/lump

Table 2: comparative production of rice in *Jeevatu* based and chemical based cultivation.

S.N.	Replication	No of seed in 1 stalk of spikelet (number)		No of fruiting stalk in lump			
		Jeevatu Based	Chemical used (no Jeevatu	Jeevatu Based		Chemical used	
				No of stalk	Non fruiting stalk	No of stalk	Non fruiting
1	a	298	172	13	0	11	0
2	b	268	146	18	1	13	1
3	c	272	188	16	0	14	0
4	d	287	183	17	0	14	2
5	e	193	198	18	2	10	0
6	f	257	204	14	0	16	0
7	g	211	191	15	0	12	1
8	h	208	187	16	1	13	1
9	i	164	217	18	0	9	0
10	j	213	240	17	1	10	2
	Mean	237.1 ± 44.92	192.6 ± 25.26	16.2 ± 1.75	0.5 ± 0.7	12.2 ± 2.2	0.7 ± 0.82

Conclusion

From the comparative analysis of rice production in Jeevatu and chemical based treatment, the *Jeevatu* was found to be highly significant on the vegetative growth, yield and quality of rice grain. Furthermore, with the application of *Jeevatu* the rice plant was found to be more resistant to diseases and pathogens. Similarly, with the application of *Jeevatu* in rice, the production was increased by 50% in comparison to the chemical based plant. In this way, this technology is helpful to minimize the cost of plant nutrition & plant protection. Therefore, from this study it is concluded that, this eco-friendly, cost effective and sustainable technology can be developed and promoted in farm houses through the use of beneficial microbes. This will ultimately help to uplift the living condition and economic status of the farmers by increasing the production.

References

Akond MA, Sanzida M and Motiur RM (2007) Distribution and abundance of *Azotobacter* in wheat fields of Bangladesh. *Bangladesh J Microbiol*. **24(2)** :151-153.

Becking JH (1981) The family *Azotobacteraceae* : 795-817. *In* M. P. Stan-, H. Stolp, H. G. Triiper, A. Balows, and H. G. Schlegel (ed.), The prokaryotes. A handbook on habitats, isolation and identification of bacteria, vol. 1. Springer-Verlag, Berlin.

Chet I, Inbar J, Hadar I (1997) Fungal antagonists and mycoparasites. In: Wicklow DT, Söderström B (eds) The Mycota IV: Environmental and microbial relationships. Springer-Verlag, Berlin.:165-184.

Deubel A and Merbach W (2005) Influence of microorganisms on phosphorus bioavailability in soils. *In*: Buscot F and Varma A (eds.), *Microorganisms in Soils: Roles in Genesis and Functions* : 177–191.

Elshanshoury AR (1995) Interaction of Azotobacter chroococcum, Azospirillum brasilense and Streptomyces mutabilis, in relation to their effect on wheat development. *Journal of Agronomy and Crop Science*. **175**: 119–127.

Eweda WE, Selim SM, Mostafa MI and Dalia AAF (2007) Use of *Bacillus circulans* as bio-accelerator enriching composted agricultural wastes E- identification and utilization of the microorganism for compost production. Proceedings of the 12th Conference of the Microbiology. Organized by The Egyptian Society of Applied Microbiology (ESAM), 18-20.

Garg SK, Bhatnagar A, Kalla A and Narula N (2001) In vitro nitrogen fixation, phosphate solubilization, survival and nutrient release by *Azotobacter* strains in an aquatic system. *Bioresearch Technology*. **80**: 101–109.

Girgis MGZ (2006) Response of wheat to inoculation with phosphate and potassium mobilizers and organic amendment.*Annals Agric. Sci*., Ain Shams Univ., Cairo, **51(1)**: 85-100.

Grondona I, Hermosa R, Tejada M, Gomis MD, Mateos PF, Bridge PD, Monte E, García-Acha I (1997) Physiological and biochemical characterization of *Trichoderma harzianum*, a biological control agent against soilborne fungal plant pathogens. *Appl Environ Microbiol* **63**: 3189-3198.

He Z and Zhu J (1988) Microbial utilization and transformation of phosphate adsorbed by variable charged minerals. *Soil Biol. Biochem*. **30**: 917–23.

Krasilinikov NA (1957) On the role of soil micro-organism in plant nutrition. *Microbiologiya*, **26**: 659–672.

Kucey RMN, Janzen HH and Leggett ME (1989) Microbially mediated increases in plant-available phosphorus. *Ad. Agron.* **42:**199–228.

Kudashev IS (1956) The effect of phosphobacterin on the yield and protein content in grains of Autumm wheat, maize and soybean. *Doki. Akad. Skh. Nauk*. **8**: 20–3.

Lin QM, Rao ZH, Sun YX, Yao J and Xing LJ (2002) Identification and practical application of silicate-dissolving bacteria. *Agr. Sci. China*, **1**: 81-85.

Maltseva NN, Nadkernichnaya EV, Kanivets NA (1995) Associations of nitrogen-fixing bacteria with winter rye, Proceedings of the 10th International Congress on Nitrogen Fixation, St Petersburg, Russia, No. 614.

Martinez, T., Moreno, M.Y., De la Rubia, J., Gonzalez-Lopez, T., 1989. Root exudates of Zea mays and production of auxins, gibberellins and cytokinins by Azotobacter chroococcum. *Plant and Soil*. **110**: 149–152.

Mishra OR, Tomar US, Sharama RA, Rajput AM (1995) Response of maize to chemicals and biofertilizers. *Crop Research*. **9** : 233–237.

Monte E (2001) Understanding *Trichoderma*: between biotechnology and microbial ecology. *Int Microbiol* **4** :1-4.

Mrkovacki N, Mezei S, Kovacev L (1996) Effect of Azotobacter inoculation on dry matter mass and nitrogen content in the hybrid varieties of sugar beet. A Periodical of Scientific Research on Field and Vegetable Crops 25 :107–113.

Okada S (1988) Lactic acid bacteria for developing a clean environment. *Biseibutsu* **4** :56-70.

Ozturk A, Caglar O and Sahin F (2003) Yield response of wheat and barley to inoculation of plant growth promoting rhizobacteria at various levels of nitrogen fertilization. *J. Plant Nutr. Soil Sci.,* **166**: 1–5.

Pal SS (1999) Interaction of an acid tolerant strain of phosphate solubilizing bacteria with a few acid tolerant crops. *Plant Soil*, **213**: 221–30.

Pandey A, Sharma E and Palni L (1998) Influence of bacterial inoculation on maize in upland farming systems of the sikkim Himalaya. *Soil Biology and Biochemistry* **3**: 379–384.

Sahin F, Çakmakçi R and Kantar F (2004) Sugar beet and barley yields in relation to inoculation with N_2 -fixing and phosphate solubilizing bacteria. *Plant Soil*, **265**:123-129.

Tchan YT and New PB (1984) Genus I. *Azotobacter* Beijerinck, 220-229. *In* N. R. Krieg and J. G. Holt (ed.), Bergey's manual of systematic bacteriology, vol. 1. The Williams & Wilkins Co., Baltimore.

Tiwari VN, Lehri LK and Pathak AN (1989) Effect of inoculating crops with phospho-microbes. *Exp. Agric.* 25 : 47–50.

Vessey JK (2003) Plant growth-promoting rhizobacteria as biofertilizers. Plant Soil, **255** : 571-586.

Vyas SC, Vyas S (1995) Integrated control of dry root of soybean. In: Lyr H, Russell PE and Sisler HD (eds) Modern fungicides and antifungal compounds. *Intercept, Andover*, 565-572.