Effect of land configuration techniques, NP levels and bioinoculants on soil available nutrients and soil microorganism in aerobic rice production in South India

N. Maragatham and G. James Martin

Department of Agronomy, Tamil Nadu Agricultural University, Coimbatore-3, India, Email maragathamm@yahoo.co.in

Abstract
A field experiment was conducted during 2007-2008 at the Wetland Farm of Tamil Nadu Agricultural University, Coimbatore to study the effect of land configuration techniques, NP levels and bioinoculants on soil available nutrients and soil microorganism for aerobic rice. Post harvest soil analysis clearly shows that the soil available nitrogen was highest (219.7 kg/ha) for the application of 100% recommended dose of fertilizers+ biofertilizers which was on par with the application of 100% recommended dose of fertilizers + biofertilizers+ AM fungi seed treatment. Lowest P status of 9 kg/ha was observed for the application of 100% recommended dose of fertilizers + biofertilizers+ AM fungi seed treatment. This was due to the solubilization of P in the soil by AM fungi which is made available for crop growth. Application of bio fertilizer enhanced the N availability and solubilized the unavailable P which in turn recorded higher N availability and low P status indicating better P uptake when applied along with recommended dose of fertilizer for aerobic rice. The population of *Azospirillum*, phosphobacteria, *Pseudomona* and *VAM*, where is notably higher because of the increase microbial load due to application of bioinoculants along with the fertilizers.

Key Words
Aerobic rice, soil available nutrients, bioincolants, soil microorganisms.

Introduction
Rice is the staple food for nearly half of the world's population, most of who live in developing countries. The demand for rice in India is projected at 128 million tons for the year 2012 and will require a production level of 3,000 kg/ha significantly greater than the present average yield of 1,930 kg/ha. The development of hybrid rice technology and the adoption of hybrids to Indian environment offer one approach to solve the problem of matching food supply to expected demand (Surekha *et al.* 1999). Nearly 50 per cent gain in food grain productivity seen in recent times has come through adoption of fertilization practices and water management in aerobic rice system (Bouman *et al.* 2005). . Since aerobic rice is recent concept, minimal effects have been made to study its performance on soil available nutrients and soil microorganisms because of the changed ecosystem of rice. Therefore the present investigation was undertaken to at the Wetland Farm, Tamil Nadu Agricultural University, Coimbatore, India during *kharif* 2007 to assess the effect of land configuration techniques and bioinoculants on soil available nutrients and soil microorganism in aerobic rice production variety (PMK(R) 3).

Materials and methods
A field experiment was conducted during 2008-2009 at the Wetland Farm of Tamil Nadu Agricultural University, Coimbatore. The soil was deep clay loam, containing 18.1%, 17.2%, 19.0% and 44.2% of fine sand, coarse sand, silt and clay respectively. The soil pH, electrical conductivity, organic carbon and soil available N, P and K were 7.3, 0.46 mS/m, 0.64% and 244, 17.2 kg/ha and 505 kg/ha respectively. The experiment was laid out in split -plot design replicated thrice. The treatments consisted of two types of land configuration techniques viz.,flat bed (M_1) and ridges and furrows techniques (M2) as main plot treatments and different combinations of fertilizers and bioinoculants as sub plot treatments viz., 100% recommended dose of fertilizers (S_1) , S_1 + biofertilizers (*Azo,spirillum*, Phosphobacteria and *Pseudomonas fluorescens*), (S_2) , S_2 + AM Fungi (S_3) , 75% recommended dose of fertilizers+biofertilizers (S_4) and S_4 + AM Fungi(S_5). The recommended dose of fertilizer is 150 : 75 : 75 kg NPK / ha. The data were subjected to statistical analysis as described by Gomez and Gomez (1984).

Result and discussion
Post harvest soil nutrient status
Soil available nitrogen was highest (219.7 kg/ha) for the application of 100% recommended dose of

fertilizers+ biofertilizers which was on par with the application of 100% recommended dose of fertilizers + biofertilizers+ AM fungi seed treatment. This was due to the nitrogen fixation by *Azospirillum* in addition to the supply of 100% recommended dose of nitrogen (150 kg/ha).There was a significant difference in the available phosphorus status of the soil for different bioinoculants application. Highest P status was recorded with the application of 100% recommended dose of fertilizers having no seed treatment (13.8 kg/ha). This was followed by 11.5 kg/ha for the application of 100% recommended dose of fertilizers + biofertilizers application. Lowest P status of 9 kg/ha was observed for the application of 100% recommended dose of fertilizers + biofertilizers+ AM fungi seed treatment. This was due to the solubilization of P in the soil by AM fungi which is made available to the crop. There was no considerable difference in the available K status of the soil due to land configuration and nutrient management techniques. Application of bio fertilizer enhanced the N availability N and solubilized the unavailable P which in turn recorded low availability of nutrient in the soil after harvest. This is a corroboration with the findings Rajesh and Thanunathan (2003) who found that higher nutrient uptake results in low nutrients in soil after harvest due to enhanced root growth and root volume in aerobic rice.

Table 1. Effect of land configuration techniques, NP levels and bioinoculants on available nutrients (kg/ha) in the soil after harvest of aerobic rice.

Treatments	Nitrogen (kg/ha)	Phosphorus (kg/ha)	Potassium (kg/ha)
M_1- Flat bed	215.1	10.9	420.9
M_2-Ridges and furrows	213.3	10.5	418.2
SEd	6.05	0.35	11.40
CD (P=0.05)	NS	NS	NS
S_1 - 100% NP	214.7	13.8	420
S_2 - 100% NP + BF	219.7	11.5	419.8
S_3 - 100% NP + BF + VAM	218.5	9.0	419.2
S_4 - 75% NP + BF	209.7	10.2	420
S_5 - 75% NP + BF + VAM	208.7	9.0	418.8
SEd	16.90	0.81	32.8
CD (P=0.05)	NS	1.71	NS

BF, Biofertilizers; VAM, Vesicular Arbuscular Mycorrhizae; Interaction not significant

Microbial enumeration

The population of *Azospirillum* was higher in all treatments except where no seed treatment was done. The significantly higher population of phosphobacteria in ridges and furrows (14.7×10^6cfu/g soil on dry weight basis) compared to flat bed which recorded a population of 11.9×10^6cfu/g soil on a dry weight basis during the active tillering stage. A significantly higher population of phosphobacteria was recorded for the application of 100% recommended dose of fertilizers + biofertilizers+ AM fungi seed treatment which recorded 17.5×10^6cfu/g soil on dry weight basis during tillering stage. This was followed by other treatments which received seed treatment with phosphobacteria. In the remaining stages of crop growth population was more in all the treatments which received seed treatment with phosphobacteria.There was a significantly higher population of *Pseudomonas* in ridges and furrows compared to flat bed in all critical stages of crop growth. All treatments which received seed treatment with *Pseudomonas* showed significantly higher populations. The application of 100% recommended dose of fertilizers having no seed treatment showed a low population of *Pseudomonas*. There was a significantly higher AM fungi infection recorded for the treatment of 75% recommended dose of fertilizers + biofertilizers+ AM fungi seed treatment (84.3percent) which was on par with the application of 100% recommended dose of fertilizers + biofertilizers+ AM fungi seed treatment (81%) at 20 days after sowing. During panicle initiation stage, both the treatments i.e., application of 100% recommended dose of fertilizers + biofertilizers+ AM fungi seed treatment and application of 75% recommended dose of fertilizers + biofertilizers+ AM fungi seed treatment showed 100% VAM infection. This is because of the action of microorganisms can be promoted and the accumulation of poisonous substances in the soil can be avoided by favourable soil aeration (Mao Zhi 1997).

Table 2. Population of soil microorganisms influenced by different land configuration techniques, NP levels and bioinoculants on aerobic rice.

Treatments	*Azospirillum* (10^5 cfu/g)	Phosphobacteria (10^6cfu/g)	*Pseudomonas fluorescens* (10^6cfu/g)	VAM infection % at PI stage
M_1- Flat bed	18.6	13.4	129.4	87
M_2-Ridges and furrows	19.0	12.4	157.3	92
S Ed	0.5	0.16	4.8	2.4
CD (P=0.05)	2.1	0.67	20.9	NS
S_1 - 100% NP	8.0	4.8	109	77
S_2 - 100% NP + BF	21.1	16.9	154.3	86
S_3 - 100% NP + BF + VAM	22.6	12.6	155.2	100
S_4 - 75% NP + BF	21.8	14.3	151.3	84
S_5 - 75% NP + BF + VAM	20.5	15.9	147.0	100
SEd	1.6	1.1	11.6	7.2
CD (P=0.05)	3.3	2.4	24.7	15.3

BF, Biofertilizers; VAM, Vesicular Arbuscular Mycorrhizae; Interaction not significant

References

Bouman BAM, Peng S, Castaneda AR, Visperas RM (2005) Yield and water use of tropical aerobic rice systems. *Agric. Water Manage.* **74**, 87-105.

Gomez KA, Gomez AA (1984) 'Statistical procedures for agricultural research'. 2nd Edition. (John Wiley and Sons: New York, USA).

Mao Z (1997) Water saving irrigation for rice. *China Rural Water and Hydropower* **4**, 45-47.

Rajesh V, Thanunathan K (2003) Effect of seedling age, number and spacing on yield and nutrient uptake of traditional Kambam chamba rice. *Madras Agric. J.* **90**, 47-49.

Surekha K, Narayana Reddy M, Kumar RM, Vijaykumar CHM (1999) Effect of nitrogen sources and timing on yield and nutrient uptake of hybrid rice. *Indian J. Agric. Sci.* **69**, 477-81.