1. INTRODUCTION

1.1 Background

Nepal is a predominantly agricultural country with an area of 147,181 sq.km and population of 231 millions people (NG, MPE 2001 report). Nepal has varieties of topography and several types of agro ecological production zones and domains have enriched it. Agriculture is the main source of Nepalese economy. Nepal Government has therefore, accorded highest priority in agriculture.

The history of rice (*Oryza sativa* L.) cultivation started before Vedic time and mentioned even in the ancient literature of 2800B.C. (NARC, Silver Jubilee, 1997). In Nepal, rice is economically, socially and culturally important crop. It plays a vital role in Nepalese economy in various ways. It provides livelihood to most of the country's population. To improve the quality of life and to increase the agriculture production for leading the country towards poverty reduction, high yield of rice production is necessary.

Rice is one of the first leading oldest cultivated crop in terms of area and production in Nepal. It is the main cereal grain and important staple food crop of Nepal. It is grown in 4.29 million Mt under the area of 1.542 hectares in the year 2004/05(MoAC, 2006).Due to the rapid population growth 2.25 per year (CBS ,2001) in Nepal, considerable deficit of food grain has been realized. Although, many attempts have been made to intensify the food grain production to meet the dietary requirement of ever increasing Nepalese population. In this connection, high yielding fertilizer responsive rice cultivars and improve cultural practices have been introduced in the country. Farmers of Nepal have started to use good rice varieties as well as general fertilizers to increase the production. Among the chemical fertilizers, nitrogenous fertilizer is mostly used and its dose in rice ranges from 50-80 kg/ha(farmer's dose).

Although the use of chemical fertilizer can increase the yield, Nepalese farmers are not able to afford it due to increasing fertilizer prices. Geographical limitations of Nepal especially in hilly regions make difficulties in transportation of the fertilizers. Apart from this, some farmers use low dose of fertilizers than recommended due to unavailability of sufficient fertilizers. The efficiency of the applied fertilizer nitrogen in the form of urea is very low. The loss of N through NH_3 volatiliztion sometimes accounts as high as 50% of applied fertilizer depending on fertilizer management and environmental condition (Fillery and Vlek 1986). The continuous use of chemical fertilizers is associated with adverse effect in its soil fertility, productivity and environmental pollution. Hence in the present context, one shouldn't ignore the indispensability of the technologies which can gradually replace the use of synthetic chemical products using biological fertilizers. Biofertilizers are environment friendly, fuel independent, cost effective and easily available source for nutrient nitrogen are the alternative source of nitrogen to the chemical fertilizers. The use of blue green algae has gained a lot of success in both laboratory and field practices. Microbial process in the sector of biofertilizers is not only quick but also consumes relatively less energy than industrial process and is most suitable for sustainable agriculture.

1.2 BGA as a means of productivity enhancing factor

Algae species have been reported from various ecological zones. Out of total 160 genera and 150 species of blue green algae reported from the world (Desikacharya, 1959), 200 species have been reported from Nepal (Prasad, 2004).

Blue green algae (BGA) are photosynthetic prokaryotic microorganisms. They are capable of utilizing solar energy to reduce atmospheric nitrogen to ammonia. Due to their structural similarity with bacteria, they are also known as cyanobacteria (Stainer and Bazina, 1997). Bryand(1989) also reported that cyanobacteria are photosynthetic prokaryotes that have oxygen evolving photosynthesis similar to higher plants. Similarly, Fleming and Haselkon (1973) reported that many cyanobacteria fix nitrogen under aerobic conditions in specialized cells called heterocyst which comprise 5-10% of cells in a filament.

Blue green algae can adopt to various soil types in environment which makes it ubiquitous throughout the world. They prefer temperature between 25-32^{0}c and P^H 6.5-7.5 in low light intensity (2500-3000 Lux). Cyanobacteria have wide range of genetic diversity in relation to their growth, nitrogen fixation capacity, tolerance to P^H, temperature and agrochemical. They show unicellular, colonial or filamentous form. The filamentous forms may be unbranched (simple), true branching or false branching. The filamentous forms show heterocystous filament or non-heterocyst filament depending upon the presence or absence of heterocyst. The heterocyst are thick walled, large cells responsible for the fixation of nitrogen. However, the unicellular and non-heterocystous, filament forms also fix atmospheric nitrogen. The colour of the thallus may be green, blue green, violet, brown or purple. The filaments usually show the gelatinous sheath outside the cell membrane. There is absence of nucleus but nuclear material occurring in a cluster of chromatic granules or fibrils in the central body. There is absence of motile reproductive spores. They reproduce either by simple cell division or by the formation simple spores such as endospore, akinetes, hormogonia, hormospores, exospores, nannocyte and planococci. Their chief pigments are chlorophyll-a, carotenes, xanthophylls, phycocyanin and phycoerythrin.

The biologically fix nitrogen by BGA becomes available to rice plant in gradual manner through oxidation and decomposition. The blue green algae may be free living or symbiotic. The symbiotic associations of cyanobacteria with some eukaryotic algae, fungi, bryophytes, pteridophytes, gymnosperms and angiosperms have been reported (Venkataraman, 1981a). Nitrogen fixed by blue green algae is released into the soil either through exudation or through microbial decomposition of the dead algal cells. Release of nitrogen through the later process provides the principal source of nitrogen available to the plant. Thus the algal growth results in a gradual build up of soil fertility. Since they also represent cells supporting microorganisms capable of photosynthesis and provide energy for nitrogen fixation independently. Blue green algae have advantage over other nitrogen fixing microbes from the agriculture point of view. The agronomic potential of BGA in rice cultivation was recognized in 1938 by De who attributed the natural fertility of tropical rice field to nitrogen fixing BGA. The cultivation of BGA in rice field as biofertilizer was started by Watanabe *et al*. and it was termed algalization by Venkataraman in 1961 (Prasad, 2003). It is reported that

BGA can fix 20-30kg N/ha. The use of BGA also increases organic matter content, nitrogen content, soil aggregation and water holding capacity of soil. According to Singh (1996), one tone of fresh BGA biomass contains about 1.2kg N/ha and 500kg of their dry matter contains around 15-20kg N.

Although Nepal is an agricultural country but the total crop production is not able to meet the demand of fast increasing population. Application of high input technologies has resulted in significant increase in agricultural productivity. There is however a growing concern about the adverse effects of indiscriminate use of chemical fertilizers on soil productivity and environmental quality. Cyanobacteria offer economically attractive to chemical fertilizers for realizing the ultimate goal of increase productivity especially in rice cultivation. In cyanobacteria also the most effective one will be the farmer’s choice because it makes farmers less independent over poor economical as well as geographical situations.

2. OBJECTIVES

2.1 Objectives

The principal objectives of the present investigation are as follows:

- To generate adequate information on BGA species, their inoculation and effect on rice yield and yield parameters.
- To determine the total nitrogen (N) and organic matter content of soil containing BGA.
- To determine the chlorophyll content of paddy.

3. LITERATURE REVIEW

Many studies have been carried out about the effect of BGA and chemical fertilizers for rice productivity.

3.1 BGA as a biofertilizer

De (1939) and Singh (1942) presented the first account of agronomic potential of BGA on rice which attributed the natural fertility of tropical paddy fields.

De, 1939 and Jenkinson, 1973 showed a steady gain of 34kg N/ha per year at Rothamsted which has been found to be associated with the use of BGA.

Singh (1942 and 1961) observed the dominant and thick brownish gelatinous mass of BGA species *Aulosira fertilissima* under wet conditions in the rice field of Uttar Pradesh and Bihar, India. However, during dry season he reported *Cylindrospermum* in the same area. Besides this, he also observed some other species like *Anabaena ambigua* and *A. fertilissima* occurring in the same areas.

Prasad (1949) reported that the amount of nitrogen fixed in rice fields of South Bihar, India was found to be 14.5kg/ha after the harvest of the crop due to the activity of BGA.

De and Sulaiman (1950) also reported that nitrogen fixation in rice fields has to be greater in the presence of the rice crop than in its absence under Indian conditions.

De and Mandal(1956) found that the amount of nitrogen fixation in between 18 to 69kg/ha has been in soils fertilized with phosphorous. However algal

N_2-fixation has been estimated about 14kg/ha during the standing rice crop in rice fields of Bihar, India and that of West Bengal ranged between 18 to 49kg/ha.

Watanabe(1962) reported that, in Japanese rice fields, the BGA inoculation of *Tolypothrix tenuis* species contributed about 22kgN/ha. He also reported that the nitrogen (N) content of soils was increased due to algal inoculation in rice fields.

Pandey (1965) reported that in the rice fields of Ballia and Ghazipur districts of Uttar Pradesh, India about 70% of the algal flora were BGA. The dominant forms found in these districts were *Aulosira, Anabaena, Anabaenapsis, Calothrix, Cylindrospermum, Fischerella, Hapalosiphon, Microchaete, Nostoc, Westiellopsis and Tolypothrix.*

According to Watanabe (1965), in a long term field trial conducted in Japan indicated a progressive increase on rice yield with BGA application which was estimated to 60kg/ha of ammonium sulphate.

Watanabe (1966) studied the effect of algal inoculation on the nitrogen status of soils in rice fields and found significantly higher amount of ammonification (30% higher over control) in third year.

Venkatatraman and Neelakantan (1967) and Jones and Stewart (1969) reported that during growing period, BGA liberated relatively large quantities of combined nitrogen mainly in the form of polypeptides with lesser amount of free aminoacids.

Prasad and Srivastava (1968) studied the systematic and ecological effects such as p^H, soil moisture, temperature and rainfall on algae of alkaline soils in the vicinity of Lucknow, U.P., India and total 46 species of cyanophyceae were reported.

Fadhl *et al*. (1969) recorded about 19.6% increasement of the grain yield of rice in Egypt with the use of 10kgN/ha along with 100gm dried algal inoculum.

Sankaram (1971) reported that the bulk of organic matter produced due to BGA application is remained in the soil and become available to the next crop as organic enrichment.

Chopra and Dube (1971) found that algal inoculation helped in continued maintenance to both total and organic nitrogen levels beyond the tillering stage of the crop and no depression on the addition of organic nitrogen due to BGA was observed even in the presence of chemically added nitrogen.

Henrikson (1971) showed an annual fixation of 15-51kg N/ha per year in rice yields in Sweden where *Nostoc* was abundant. On the other hand, an addition of 4-44kgN/ha per year in a lakeside where *Nostoc, Anabaena*, *Cylindrospermum* and *Calothrix* species of BGA were existing.

ICAR (1971) reported that algalisation gave 12.3% rice yield increment over chemical application along in the field experiment conducted at Moradabad, India.

Fogg's *et al*. (1973), Roger and Kulasooriya (1980) documented the role of N_2 fixing BGA in the maintenance of fertility of rice fields.

Pantastico and Gonzales (1976) showed 22.7% increased in grain yield of rice over control due to algal inoculum of *Nostoc commune* in the rice field of Philippines and it was comparable to NPK fertilized plot.

Watanabe *et al.* (1978a) reported that the nitrogen fixation in rice fields was mainly associated with the activity of BGA rather than other microorganisms on the basis of ARA techniques.

Watanabe and Cholitkhul (1979) showed in addition of 18-45kg N/ha due to diazotrophic BGA using acetylene reduction assays techniques, *in-situ*.

Roychoudhary *et al.* (1979) reported that algal application resulted in an improvement in soil aggregation status and their by water stable aggregates.

Venkataraman (1979a) studied the effect of algal application on rice with or without chemical fertilizers in the various states of India namely Kerala, Orissa, Utter Pradesh and Andhra Pradesh. Based on the findings, he concluded that application of BGA contributed about 25-30kg N/ha per cropping season.

Srinivasan (1979) grew algae in the field for two months prior to transplantation. He reported that the grain yield was increased by 33.6% over control in algae grown pots, even in the absence of any added fertilizers.

FAO (1981) showed that algal application at the rate of 10kg/ha contributed about 22% additional rice grain compare to uninoculated plots.The findings were obtained on the basis of 160 field trials conducted in Madhya Pradesh, India.

Venkataraman (1981a) observed that in the areas were nitrogenous fertilizers are not used, algal application contributed the benefit of applying 25-30kg N/ha. In contrast to this when fertilizers were used the dose could be reduced to the extent of 25-30kg N/ha supplemented with BGA application to get the same yield. He also reported that even at higher dose of N application, the use of algal application has been found beneficial.

Yamamuro (1986) reported that the total amount of N fixed due to BGA application during the whole rice growing period was about 2.1g/m2 (21kg/ha) in the semi-ill drained field and about 1.2g/m2 (12kg/ha) in the well drained field.

Ram *et al.* (1986) reported the increased of rice yield by 17.9% more over control due to algal inoculation at the rate of 10kg/ha in a field experiment conducted in agricultural research station, Sarkando, Bisalpur, India.

Baral *et al.* (1988) collected blue green algal patches from ten rice fields of Kathmandu valley and measured the nitrogen fixation rates. The blue green algal texa reported were *Oscillatoria sp., Phormidium ambiquum, Spirulina sp.*A, *S. sp.*B, *Schizothrix pulvinata, Anabaena fertilissima, A. doliolum, Nostoc calcicola, N. ellipsosporum, Cylindrospermum stagnale* and *Aphanothece sp.*

Baral (1995a) studied the role of blue green algae in the sense of fertilizer, water quality and energy.

Kaushik (1995a) reported that with BGA application in combination with lower dose of fertilizer nitrogen in Indian rice fields soils, not only 25-30kg N/ha per season was saved but also sustained soil productivity considerably.

Singh (1996) reported that BGA added not only nitrogen and carbon but also provided beneficial effects on physico-chemical properties and biological activities in rice fields.

IARI (1996) found that the BGA as a biofertilizer in flooded rice fields have the potentiality to contribute 20-78kg N/ha depending on the intensity of multiplication.

Das (1997) surveyed the different ecological regions of Chitwan and Nawalparasi districts of Nepal. The most frequently presents strains of BGA were *Anabaena, Nostoc, Oscillatoria* and *Scytonema.*

Gyawali and Prasad (1998) identified seven strains of BGA from the rice fields of Rupendehi district of Nepal. The strains were *Anabaena, Tolypothrix, Oscillatoria, Plectonema, Scytonema, Lyngbya* and *Cylindrospermum.*

Panta (1998) reported 29 species of BGA belonging to four families and twelve genera collected from the rice field of Lamjung district of Nepal.

Mishra and Pabbi (2004) highlighted on Cyanobacteria as a potential biofertilizer for rice. Rice yield increase by 12.26-19.48% has been reported.

Prasad (2005) isolated thirty one strains of BGA from the rice field soils of Bagmati and Narayani zone. Five nitrogen fixing BGA strains inoculum was taken for the study of their effect on rice yield and other parameters. The redult revealed that the average increase in grain and straw yield at these stations was 7.53-21.2% and 6.57-21.6% respectively.

Ariosa *et al.* (2005) reported that the incorporation of Cyanobacterial blooms could add 4-12kg N/ha to soil.

Giri (2006) identified 27 species of BGA from the rice soils of Jhapa and Dhankuta districts of Nepal.

3.2 Chemical fertilizer

Kolenbrander (1972) stated that nitrogen loss from fertilizer is higher on light soils than those on clay soils. Nitrogen losses increase as the amount of applied fertilizer increases. Among the plant nutrients responsible for eutrophication, phosphorus and nitrogen has been found to be the most important elements.

Kimmo (1994) reported that nitrate leaching is maximum in flooded soil, when nitrate is ingested, it reduces to nitrites which is a source of health problems to infants. Nitrates oxidize haemoglobin to methaemoglobin which is not able to transport oxygen to the cells.

Araragi *et al.* (1978) reported that application of phosphatic fertilizers stimulated BGA growth and nitrogen fixation activity considerably.

Saha *et al.* (1982) reported that availability of nitrogen was more to rice plants which BGA inoculum was applied without area in a flooded rice field.

Bhattarai *et al.* (2002) have recommended dose of NPK as 100:40:30kg/ha. Phosphatic and potassic fertilizer is recommended to use as basal dose while for better efficiency, nitrogenous fertilizer is recommended to apply in 2-3 splits.

Basnet (2004) stated that there is 60-70% loss of nitrogen when it is top dressed through urea under submerged condtion.

4. MATERIALS AND METHODOLOGY

4.1 Study area

The effect of BGA as biofertilizer for rice was investigated in the field experiment and pot experiment in the year 2005.

4.1.1 Location and topography

The research site for field experiment is Sainbu, V.D.C.-5, Bhainsepati of Lalitpur. The research site lies in 27° 40' N latitude and 85° 20' E longitude at altitude of 2086m. The pot experiment was conducted in the green house of Central Department of Botany, T.U., Kirtipur, located in between 27°40 – 27°41' N latitude and 85° 16'– 85° 18' E in the South West border region of Kathmandu valley at an altitude of 1400m above level.

4.1.2 Climatological data analysis

The climatic data of the research sites were collected from the department of Hydrology and Meteorology, Babarmahal, Kathmandu. In the year 2005, the mean of maximum and minimum temperature of Lalitpur was 24.78(°C) and 10.76(°C) respectively. The average maximum and minimum temperature in Kathmandu was 26.04(°C) and 12.71 (°C) respectively. Similarly, the annual rainfall was 98.53mm in Lalitpur and 102.99mm in Kathmandu.

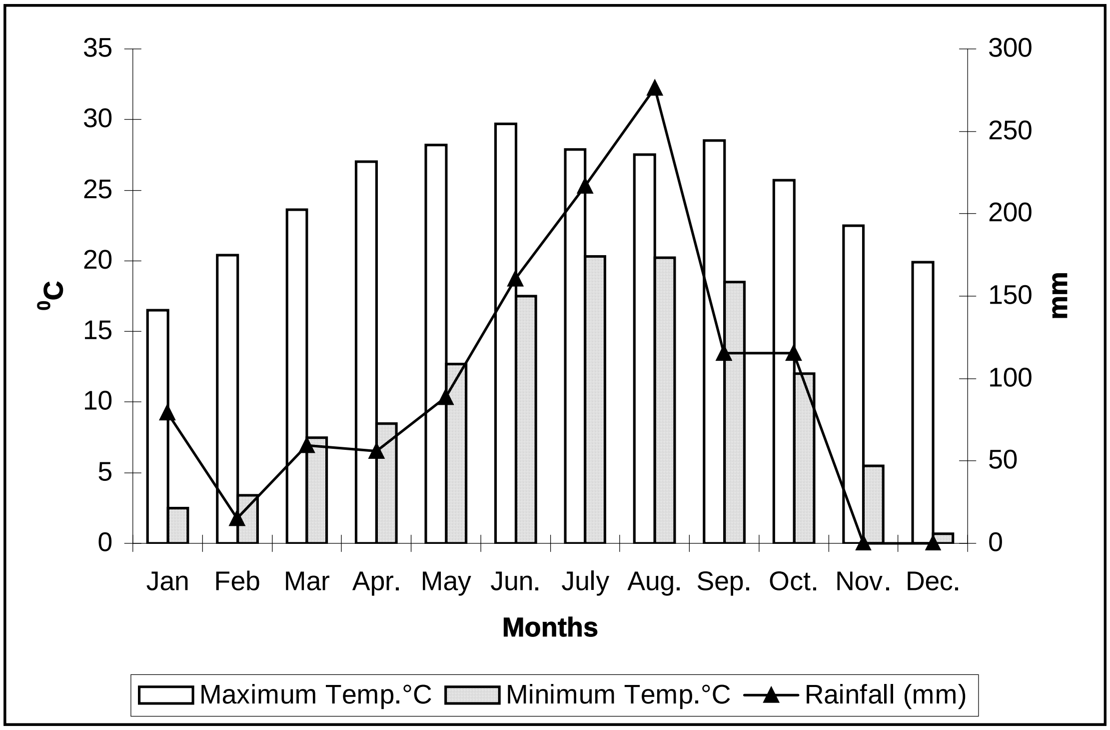

Fig.1: Graphical Representation of Climatic data of Lalitpur (2005).

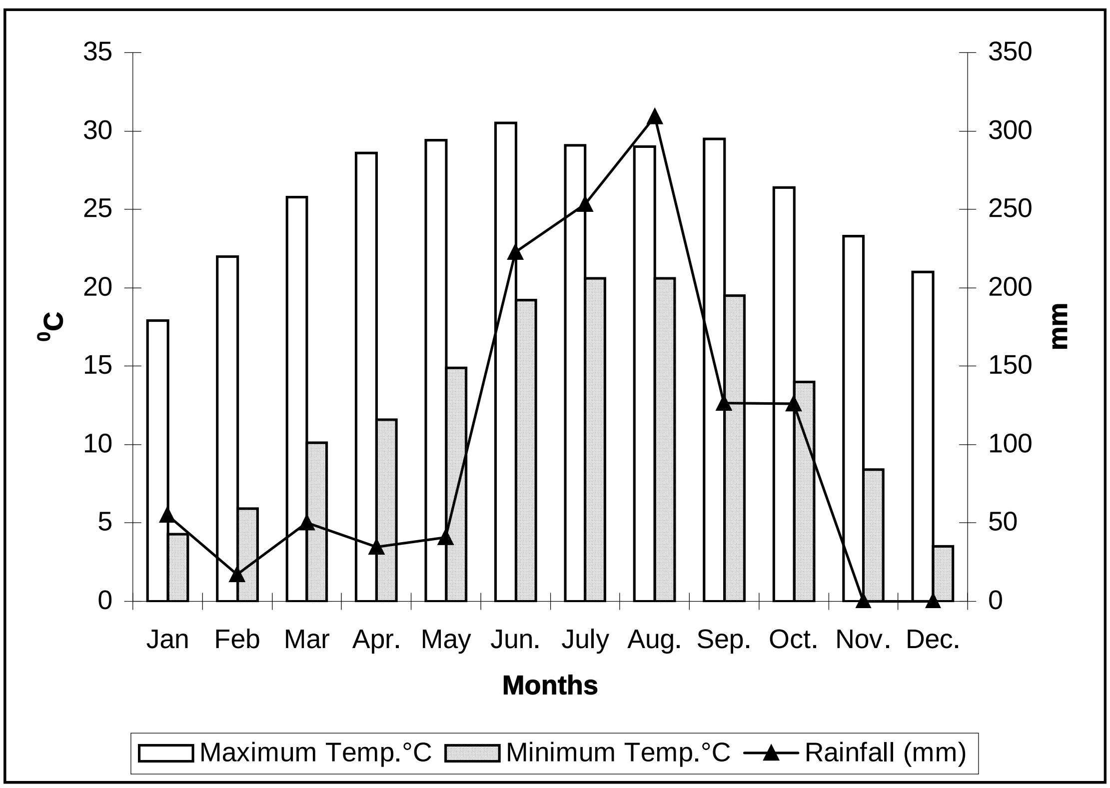

Fig.2: Graphical Representation of Climatic data of Kathmandu (2005).

4.1.3 Soil

The soil in both the experimental sites was acidic and rich in nitrogen content. The soil of Kirtipur was found to be more acidic (pH 5.4) than that in Bhainsepati (pH 6.5) while the soil in pot experiment was richer in nitrogen (N) content (.17%) than the soil of field (.15%).The soil samples of both sides were loamy.

4.2 Materials and methods

4.2.1 Materials

4.2.1.1 Plant material

The rice variety, NR10414-34-2-3 having crop duration of 140 days was collected from the Agriculture Botany Division, NARC, Khumaltar Lalitpur Nepal.The production of this variety was found upto 9.8 ton/ha in different field trials by NARC. Similarly, the rice variety Mansuli having crop duration of 150-155 days and production 4.5-5ton/ha was collected from LI-BIRD, Chitwan, Nepal.

The seeds were sown in a seed bed measuring 1m X 0.5m (50cm) Twenty two days old rice seedlings were transplanted by keeping distance according to local farmers. In field, 2-3 seeding per hill was maintained while in pot 4, healthy plants per pot was maintained.

4.2.1.2 Algal inoculum

Soil based BGA fertilizer was used in the experiment. The inoculum contained species of *Nostoc, Anabaena, Westiellopsis, Aulosira* and *Scytonema.* The pure *Anabaena* inoculum also used separately**.** The inoculum was applied at the rate of 10kg/ha. The level of water was maintained 5-10cm for BGA multiplication.

4.2.1.3 Chemical fertilizer

The main chemical fertilizer used were Nitrogen, Phosphorous and Potash in the ratio of 80:30:30 kg/ha. Nitrogenous fertilizer was used in three splits. The other two were applied as basal dose.

Table 1 : Total nutrient content of chemical fertilizers used in the experiment

Name of Fertilizers	Contents(%)			Form
	Nitrogen (N)	Phosphorous (P)	Potassium (K)	
Urea	46	-	-	White coloured prills free floating, soluble in water.
Single Super-Phosphate	-	16	-	Dirty grey powder / granular hygorscopic form.
Muriate of Potash	-	-	60	Reddish / light grey crystalline, non-hygroscopic form.

4.2.3 Method

4.2.3.1 Field experiment

The field experiment was carried out in Sainbu, Bhainsepati of Lalitpur. Each plot measured 2m X 2m.The field was designed as Complete Block Design.The treatments were six and the number of replications was three. The spacing between the hills was done according to the local farmers practice.

Table 2: Treatments in the field experiment

Treatment	N (Kg/ha)	P (Kg/ha)	K (Kg/ha)	BGA (10kg/ha)	Method of Application
T_1	0	0	0	-	
T_2	80	30	30	-	N used in three splits
T_3	0	0	0	+	Inoculation during transplantation
T_4	0	0	0	*Anabaena* only	Inoculation during transplantation
T_5	30	20	20	-	N used in three splits
T_6	30	20	20	+	N used in three splits

4.2.3.2 Pot experiment

Pot experiments were carried in the green house of CDB Kirtipur. Each pot contained 6 kg soil. The number of replication was three and there were six treatments each to both the rice varieties.BGA was inoculated at the rate of 10kg/ha during transplantation. The treatments for rice variety Mansuli were represented by P(M) in each.

Table 3: Treatments in the pot experiment

Treatment	N (Kg/ha)	P (Kg/ha)	K (Kg/ha)	BGA (10kg/ha)	Method of Application
P_1	0	0	0	-	
P_2	80	30	30	-	N used in three splits
P_3	0	0	0	+	Inoculation during transplantation
P_4	0	0	0	*Anabaena* only	Inoculation during transplantation
P_5	30	20	20	-	N used in three splits
P_6	30	20	20	+	N used in three splits

4.2.4 Chemical analysis of soil sample

The soil samples before rice cultivation and after harvest were colleted. Those samples were kept in airtight polythene bags and brought to laboratory for analysis.

4.2.4.1 Nitrogen estimation

The total nitrogen content of the soil was determined by Modified Kjeldahl method (Jackson, 1973). The organic matter was oxidized by treating soil with conc. H_2SO_4 to convert organic compound into $(NH_4)_2SO_4$ and also to drop ammonium ions present in soil. The liberated ammonia has been estimated by collecting it in a conical flask containing mixed indicator. A part of indicator neutralize by ammonia was determined by titrating against an acid of known strength (0.01 N HCl).The method included three steps:

1. Digestion
2. Distillation
3. Titration

1. Digestion

1gm of dry soil sample was mixed with 3.5gm K_2SO_4 and 0.4gm $CuSO_4$ in a digestion flask. Then, 10ml of Nitrogen free conc.H_2SO_4 was added. The mixture was digested over a heating mantle.The duration of digestion was 2-3 hrs. After a complete digestion, the flask was allowed to cool and about 50ml of distilled water was added to the digested mixture.

2. Distillation

The digested solution was transferred to distillation apparatus. Then about 40ml of 40% NaOH was added. Then, the mouth of distillation appratus was closed. 10ml of mixed indicator solution (0.3gm in 500ml 95% ethanol) was placed in a conical flask. The distillation apparatus was connected in such a way that the end of condenser was dipped below the surface by boiling the solution in the round bottom flask. Up on steam distillation, NaOH reacted with $(NH_4)_2SO_4$ to liberate ammonia which was collected in mixed indicator solution. The distillation was continued for 7 to 10 minutes.

3. Titration

After about 40ml of distillate was collected in the conical flask, it was disconnected from the condenser and titration was carried out with 0.01 N HCl.

The volumes of acid consumed by both blank and samples were noted and the total nitrogen content (N %) was calculated by using following formula:

$$N\ \% = \frac{(T\ ZB)\ x\ 14x\ N\ x\ 100}{\text{Weight of sample (gm)}}$$

Where,

T = Volume of acid used for the titration of sample

B = Volume of acid used for the titration of blank

N = Normality of the acid used

Organic matter analysis

The organic matter was determined by Walkey-Black (1938) method. In this method, 0.5gm of air dry soil sample was taken in a conical flask of 500ml. To this, added 5ml of 1N $K_2Cr_2O_7$. After that, 10ml of Conc.H_2SO_4 was added and swirled. It was allowed to rest for 30minutes. There after 100ml of distilled water was added to dilute the reaction mixture. Then 5ml of H_2SO_4 solution and 0.5ml of diphenylamine indicator were added one by one. Then the solution was titrated against 0.5N ferrous ammonium sulphate $[Fe(NH_4)_2SO_4]$ till the blue violet colour of the solution mixture was changed to green. A blank (without soil) was also run simultaneously.

The organic matter present in the soil sample was calculated by following formula:

$$\%\text{Carbon in soil} = \frac{N\,(B - C)}{\text{Wt. of soil (gm)} \times 0.003 \times 100}$$

Where,

N = Normality of ferrous ammonium sulphate $[FeSO_4\ (NH_4)\ 2SO_4\ 6H_2O]$.

B = Volume of ferrous ammonium sulphate used for blank.

C = Volume of ferrous ammonium sulphate used for sample.

4.2.5 Chemical analysis of plant material

Leaf samples were collected at the milking stage of grains for chlorophyll estimation.

4.2.5.1 Chlorophyll estimation

The chlorophyll estimation of the rice NR 10414 and Mansuli was done after 58 days of transplantation of rice in pots. About 0.2gm of fresh leaves of *Oryza sativa* L. was taken and ground in morter adding 80% acetone. The mixture was filtered and the final volume of filtrate was made 8ml. The absorbance was measured at 645nm, 652nm and 663nm using as a reference by spectrophotometer.

Expression used for chlorophyll estimation:

$$\text{Chl.a} = [12.7\ (\text{OD } 663) - 2.69\ (\text{OD } 645)] \times \frac{V}{1000 \times W}\ \text{mg/gm}$$

– F.W. of tissue.

$$\text{Chl.b} = [22.9\ (\text{OD } 645) - 4.68\ (\text{OD } 663)] \times \frac{V}{1000 \times W}\ \text{mg/gm}$$

– F.W. of tissue.

$$\text{Total Chl.} = \frac{\text{OD } 652 \times 1000}{34.5} \times \frac{V}{1000 \times W}\ \text{mg/gm of fresh weight of tissue.}$$

Where,

V = Volume of solution

W= Weight of sample

4.2.6 Measurement of yield and yield paramerers

In both the field and experimental sites, the plant height was recorded from the ground to the tip of longest leaf at the maturation of rice plant. The number of panicles per plant in both the experimental sites was recorded at the time of harvest. The grain and straw yield were measured after harvest. The number of grains per panicle and weight of 1000grains were calculated.

4.2.7 Statistical analysis

Statistical analysis was done by using Analysis of Variance (ANOVA) one way classifiction system. The data obtained were analysed using application software-microsoft excel. The significant difference between the treatments were analysed and used to compare the the marginal means to obtain plausible discussions.

5. RESULT

5.1 Results on the effect of NPK treatment on the rice yield and yield parameters

In the field experiment, NPK (80:40:30) increased grain yield and straw yield by 12.8% and 15.1% respectively. When the dose of NPK is reduced to 30:20:20, the grain yield was increased by 9.3% and the straw yield was increased by 12%.

In the pot experiment, NPK (80:40:30) increased grain yield by 20.9% and straw yield by 16.9% in case of rice NR10414 whereas at the same dose the grain yield increased by 20% and straw yield by 19% in case of rice Mansuli. When the dose of NPK is reduced to 30:20:20, the grain yield was increased by 9.1% and straw yield by 9.2% in case of rice NR10414 whereas at the same dose of NPK the grain yield was increased by 10% and straw yield by 11% in case of rice Mansuli.

5.2 Results on the effect of BGA inoculation on the rice yield and yield parameters

The strains of BGA were multiplied luxuriously. The increased in grain yield by BGA inoculation (inoculum mixture) was15.1% and the straw yield was 14.5% in the field experiment. Similarly, the single inoculum of *Anabaena* sp. increased grain yield by 7% and straw yield by 7.2% in the field experiment.

In the pot experiment, the inoculum mixture of BGA increased grain yield by 19.1% and straw yield was increased by 11.1% in case of rice NR10414.

The BGA mixed inoculum increased grain yield and straw yield by 18.6% and 16.7% respectively, in case of rice Mansuli. The inoculum of *Anabaena sp.* increased grain yield by 6.4% and straw yield by 7.9% in case of rice NR10414 whereas the increased by *Anabaena sp.* in grain yield was 7.1% and in straw yield was 7.2% in case of rice Mansuli.

The BGA inoculum with reduced dose of fertilizers (NPK-30:20:20) resulted the maximum yield in comparision to other treatments used in the experiments. In this condition, the grain yield was increased by 20.9% and the straw yield was increased by 18.1% in the field experiment.

In the pot experiment, the inoculum mixture with fertilizers increased the grain yield by 23.6% and straw yield by 20.4% in case of rice variety NR10414. Under same conditions the grain yield was increased by 22.9% and straw yield by 22.2% in case of rice variety Mansuli.

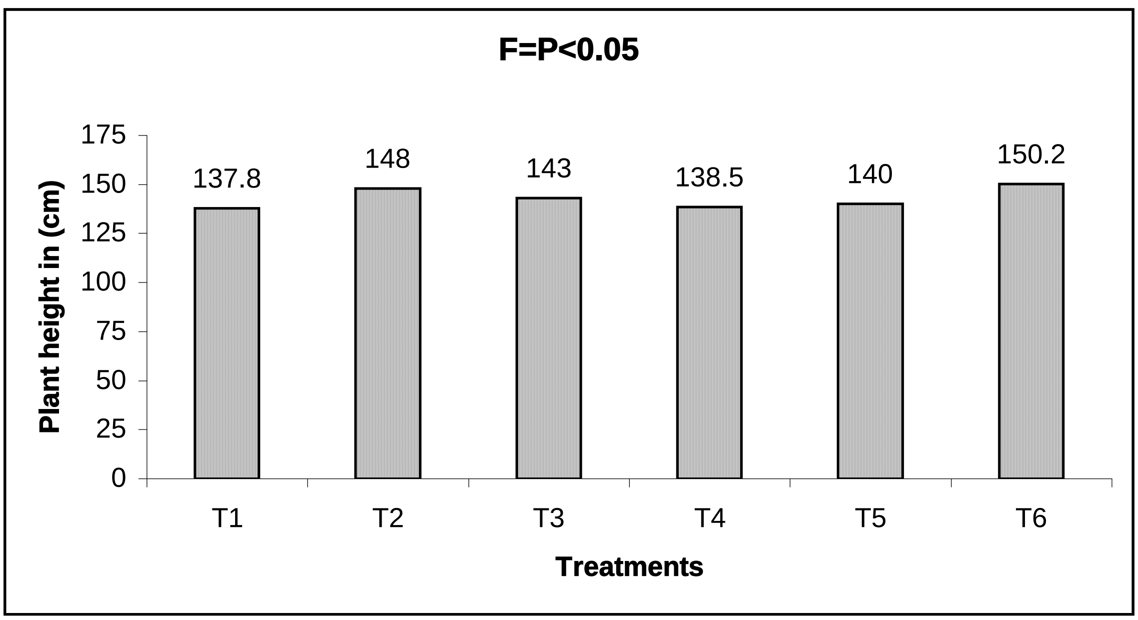

Fig. 3 : Graphical Representation of Plant height (cm) in the field.

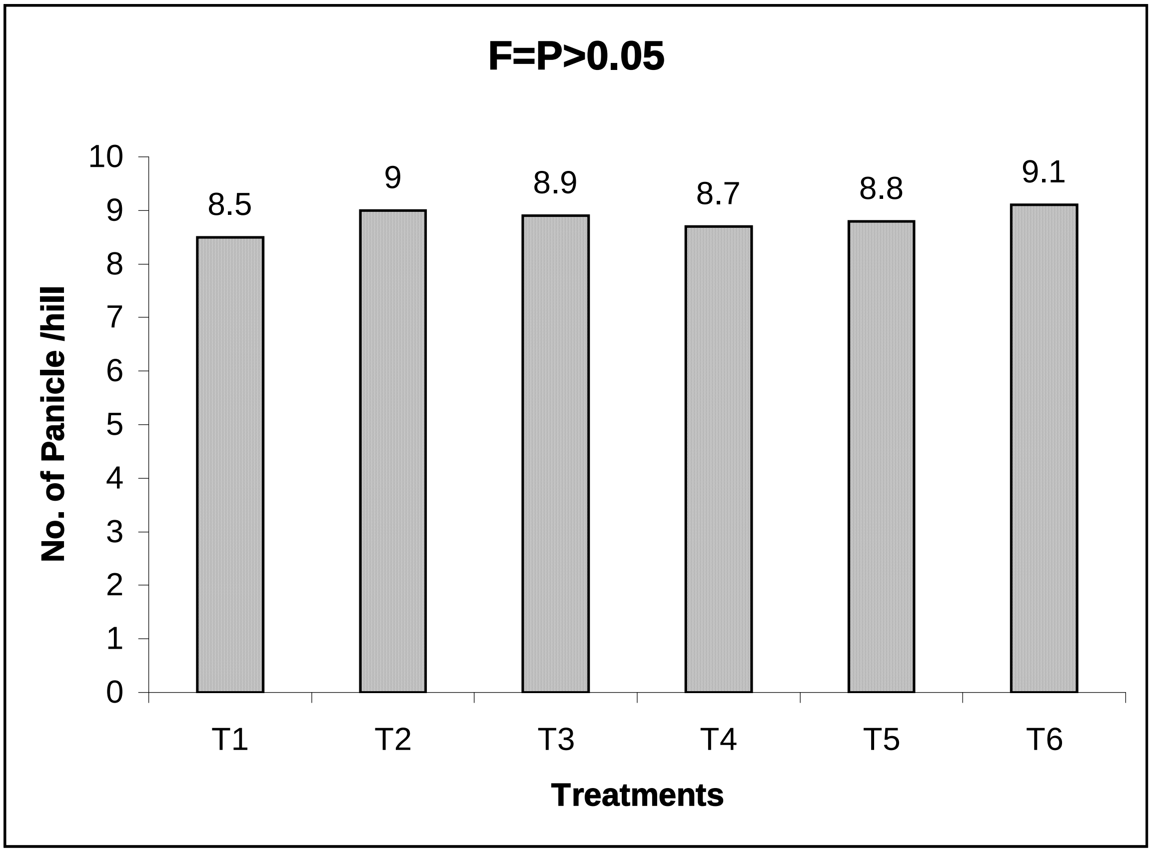

Fig. 4 : Graphical Representation of no.of Panicle/hill in the field.

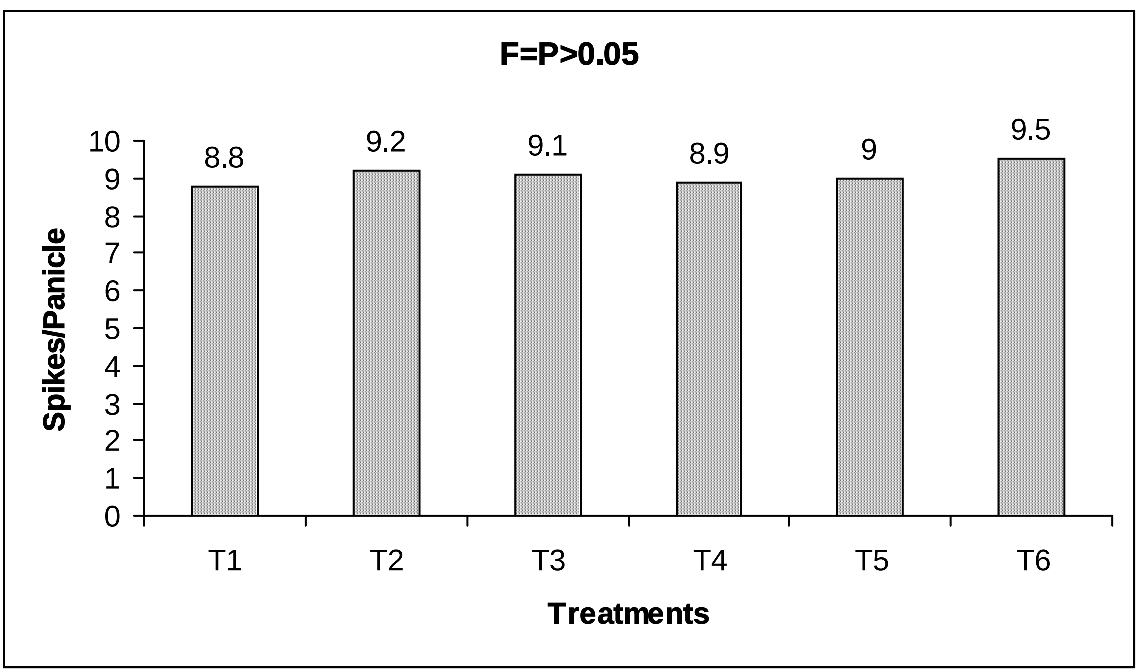

Fig. 5 : Graphical Representation of spikes/panicle in the field.

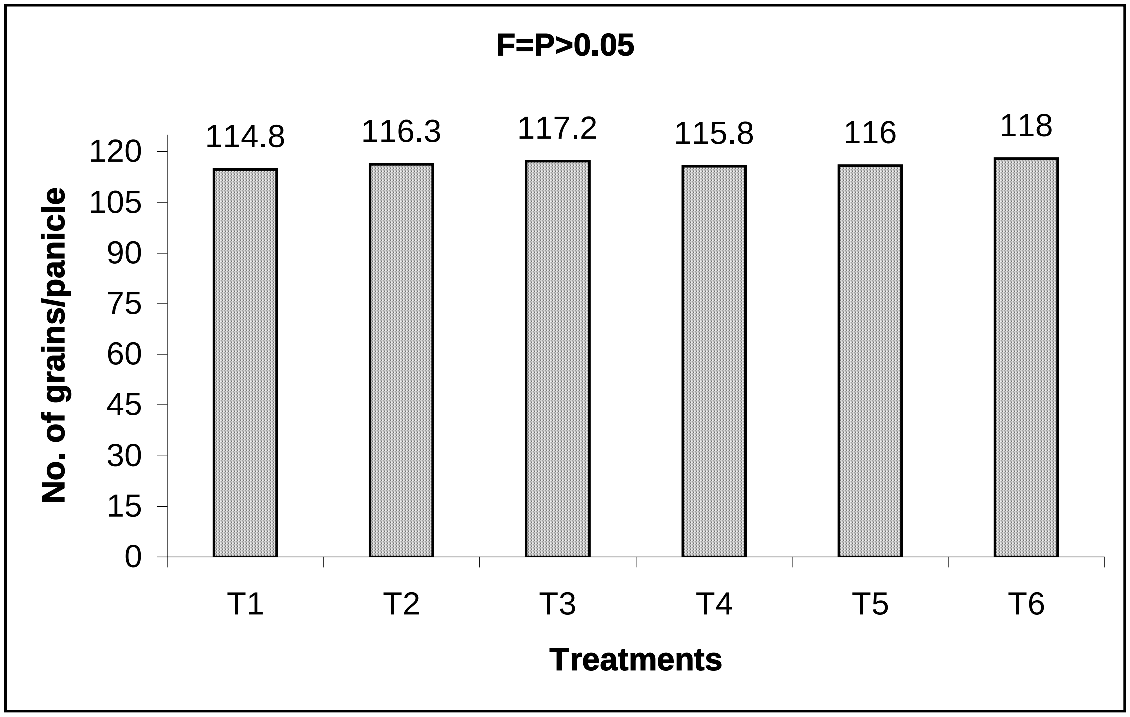

Fig. 6 : Graphical Representation of no. of grains/panicle in the field.

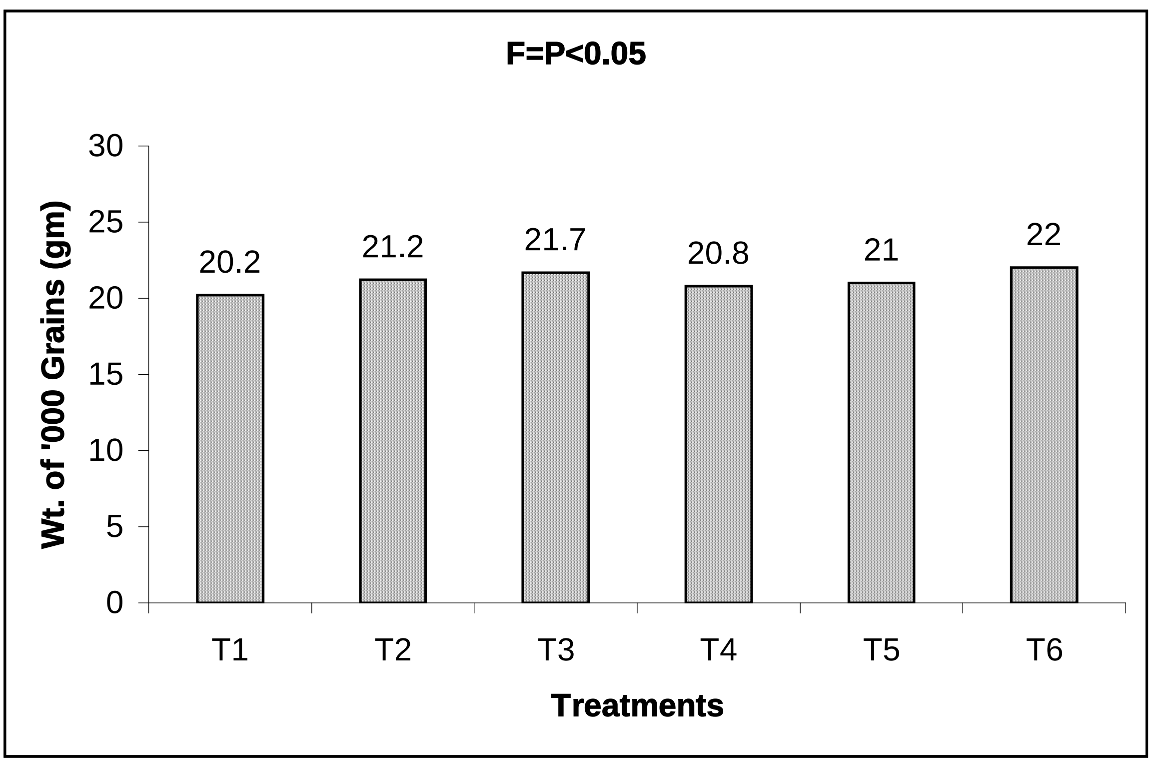

Fig. 7 : Graphical Representation of Wt. of 1000 grains (gm) in the field.

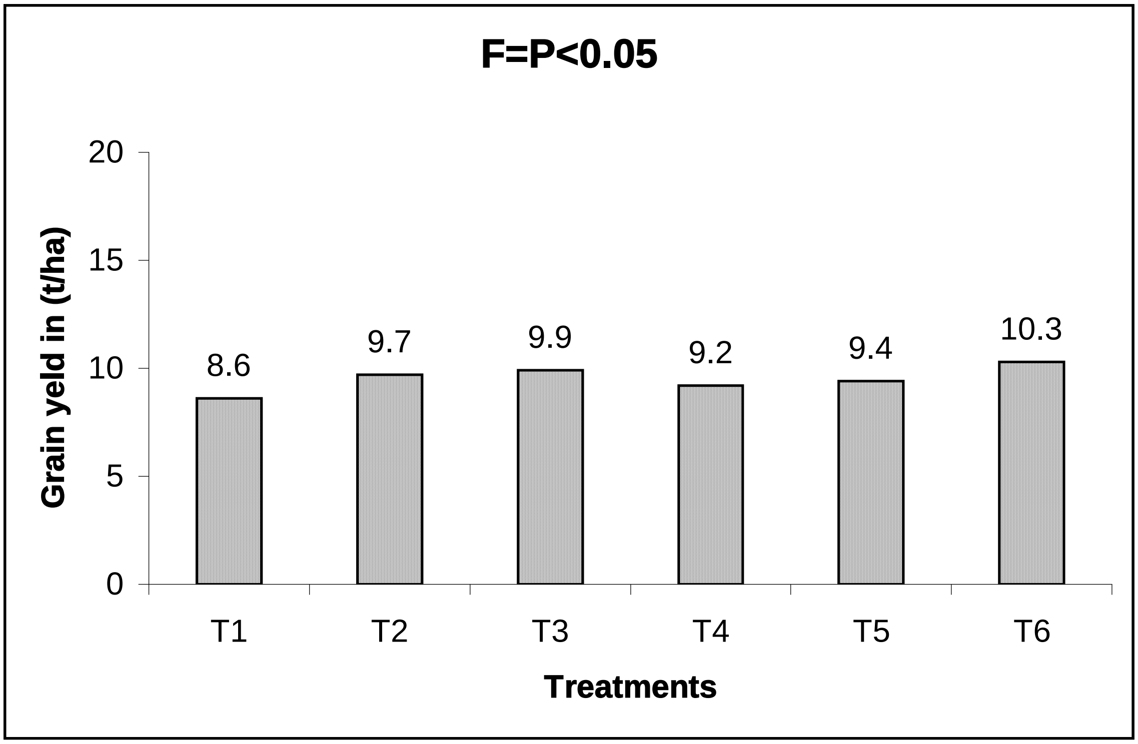

Fig. 8 : Graphical Representation of Grain yeld in (t/ha) in the field.

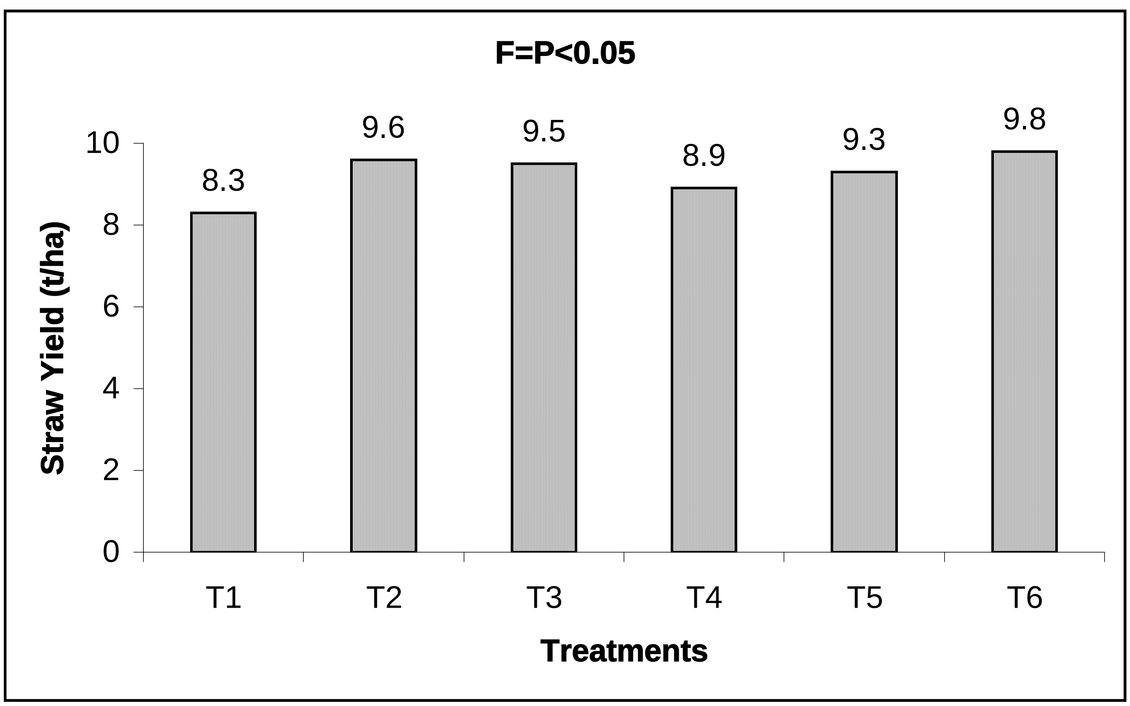

Fig. 9 : Graphical Representation of straw yleld (t/ha)in the field.

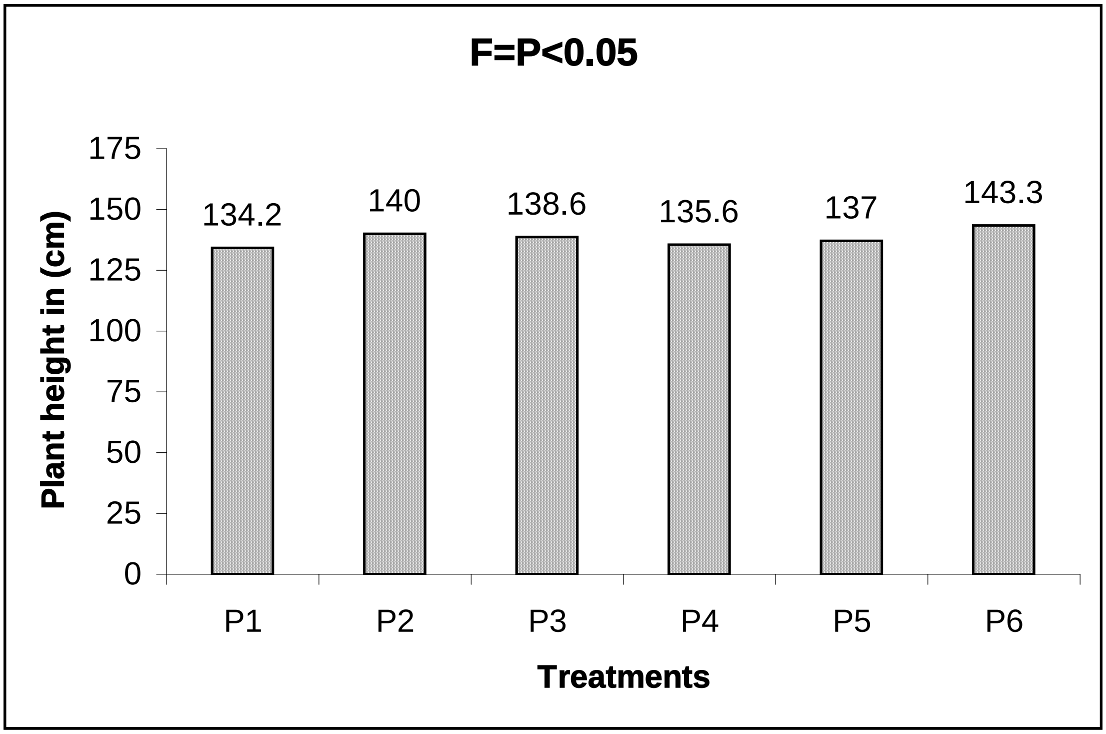

Fig. 10 : Graphical Representation of Plant height (cm) in the pot (Rice:NR 10414).

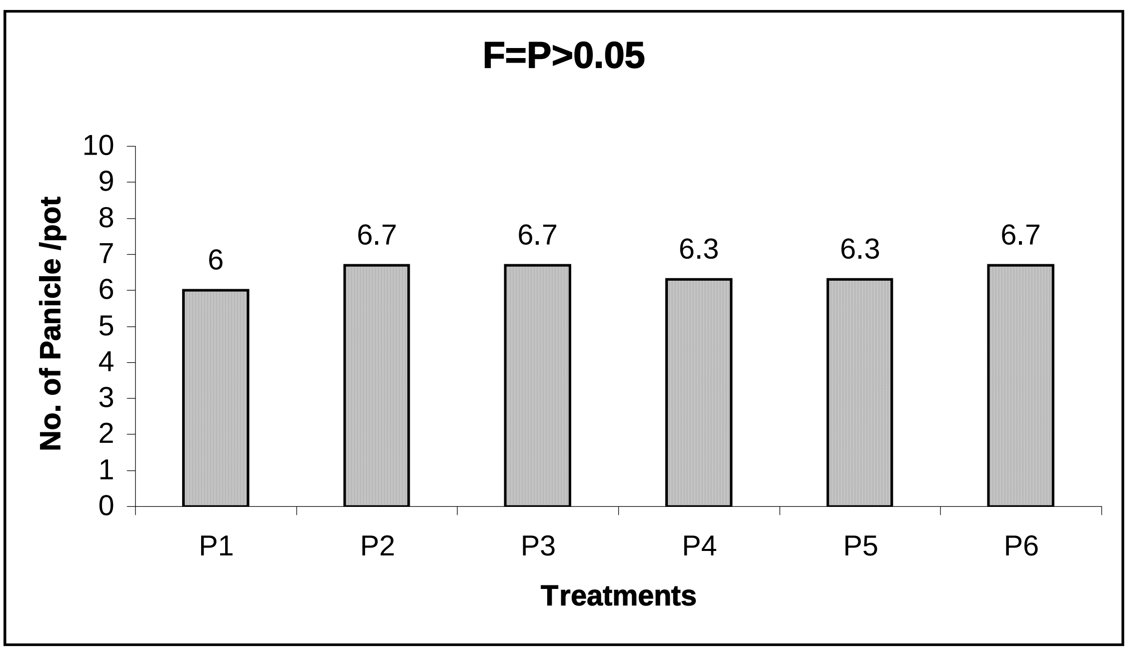

Fig. 11 : Graphical Representation of no. of panicle/pot in the pot (Rice:NR 10414).

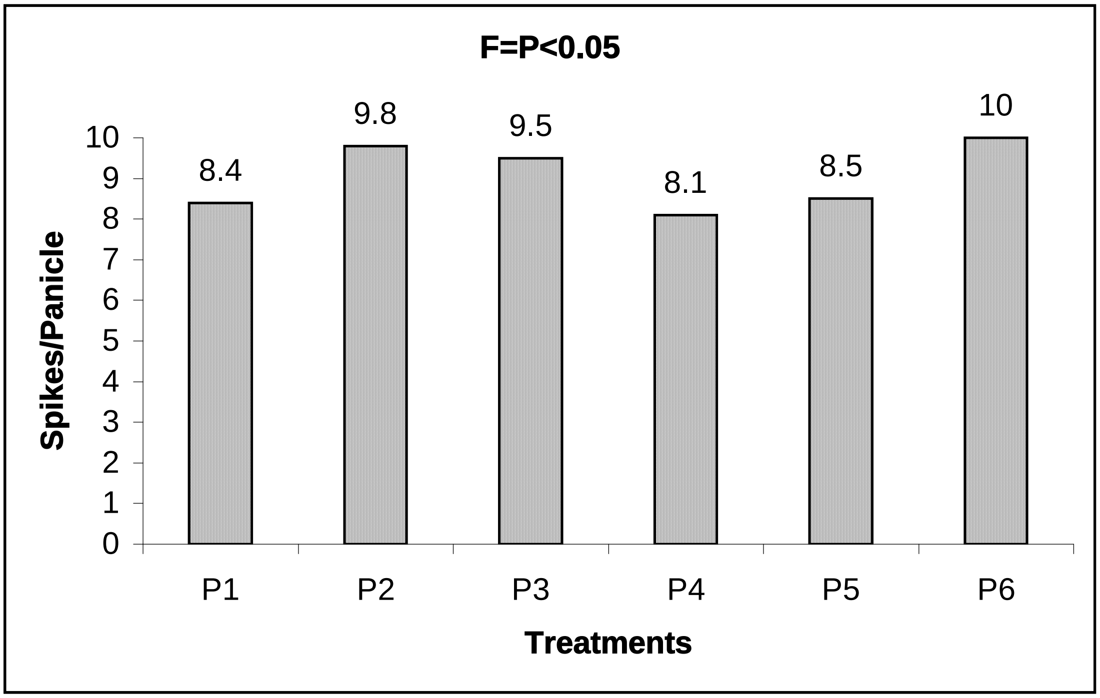

Fig. 12 : Graphical Representation of no. of Splikes/pancle in the pot (Rice:NR 10414).

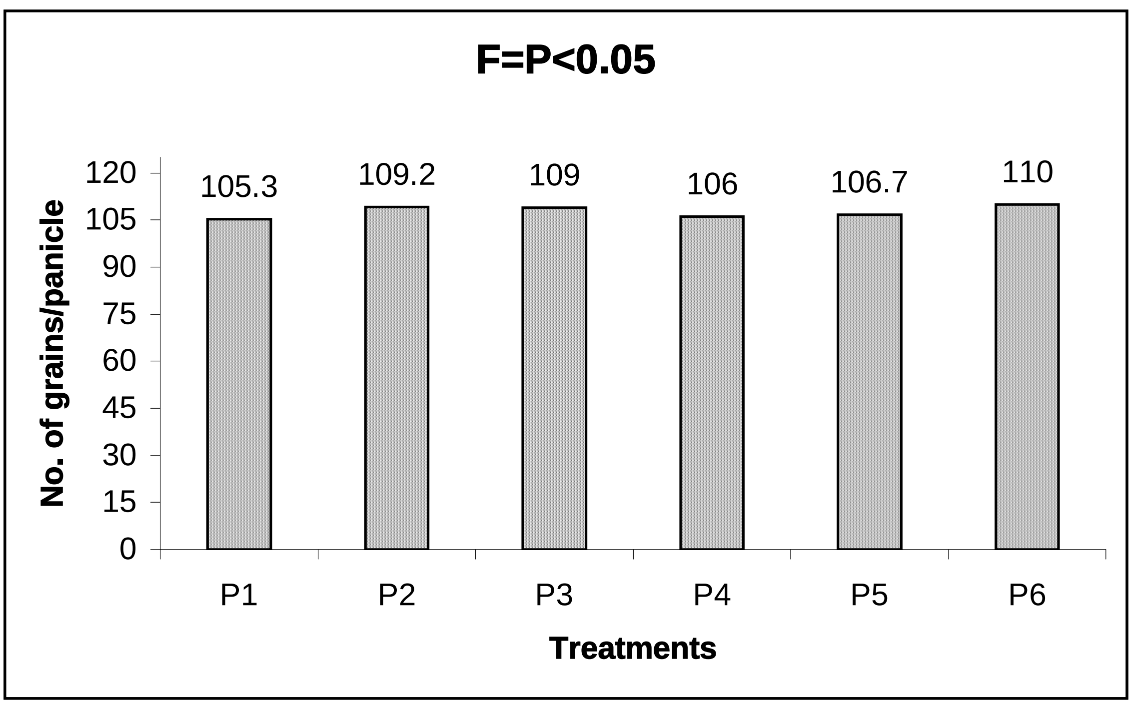

Fig. 13 : Graphical Representation of no. of grains/pancle in the pot (Rice:NR 10414).

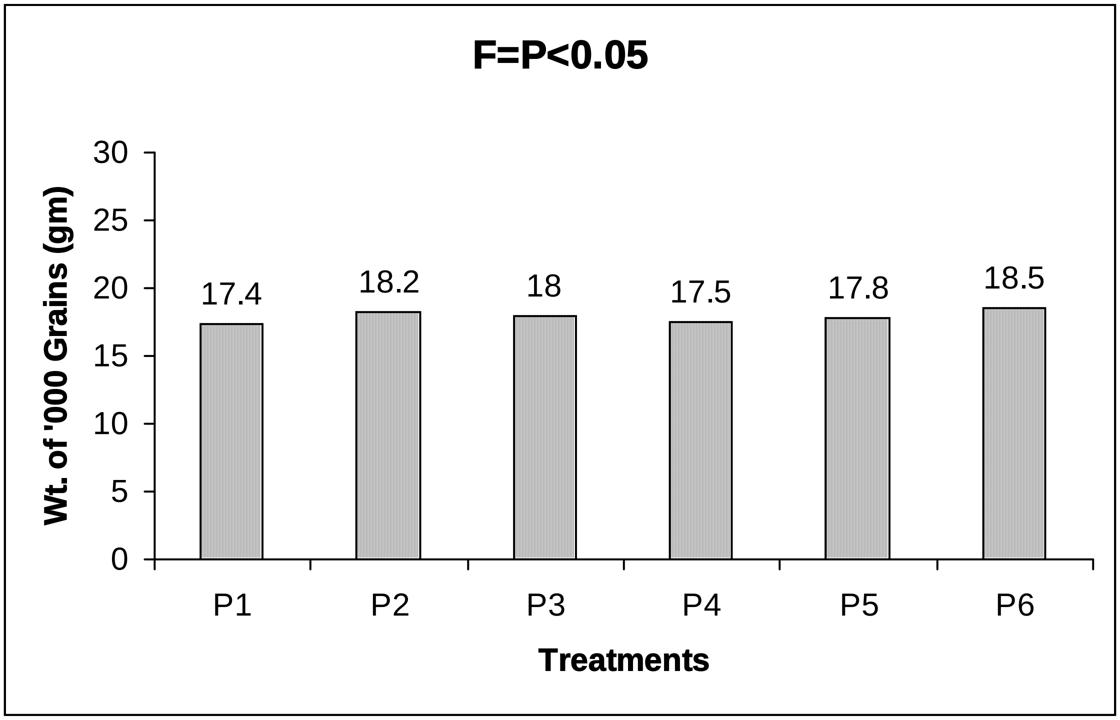

Fig. 14 : Graphical Representation of Wt. of 1000 grains (gm) in the pot (Rice:NR 10414).

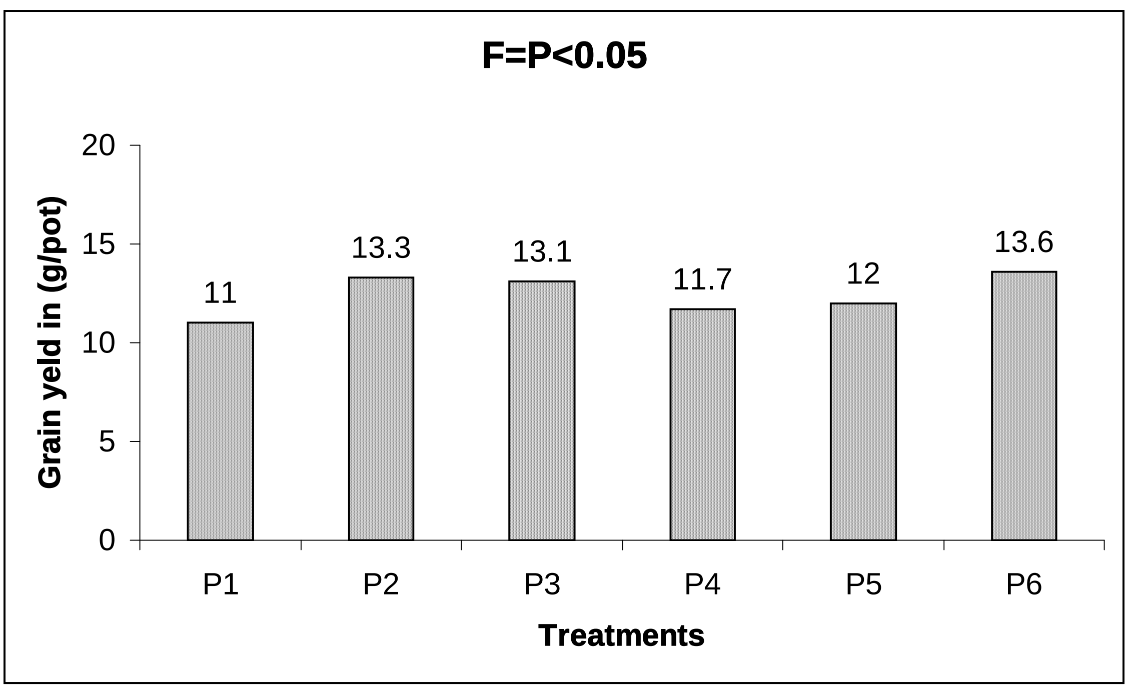

Fig. 15 : Graphical Representation of grain yield (g/pot) in the pot (Rice:NR 10414).

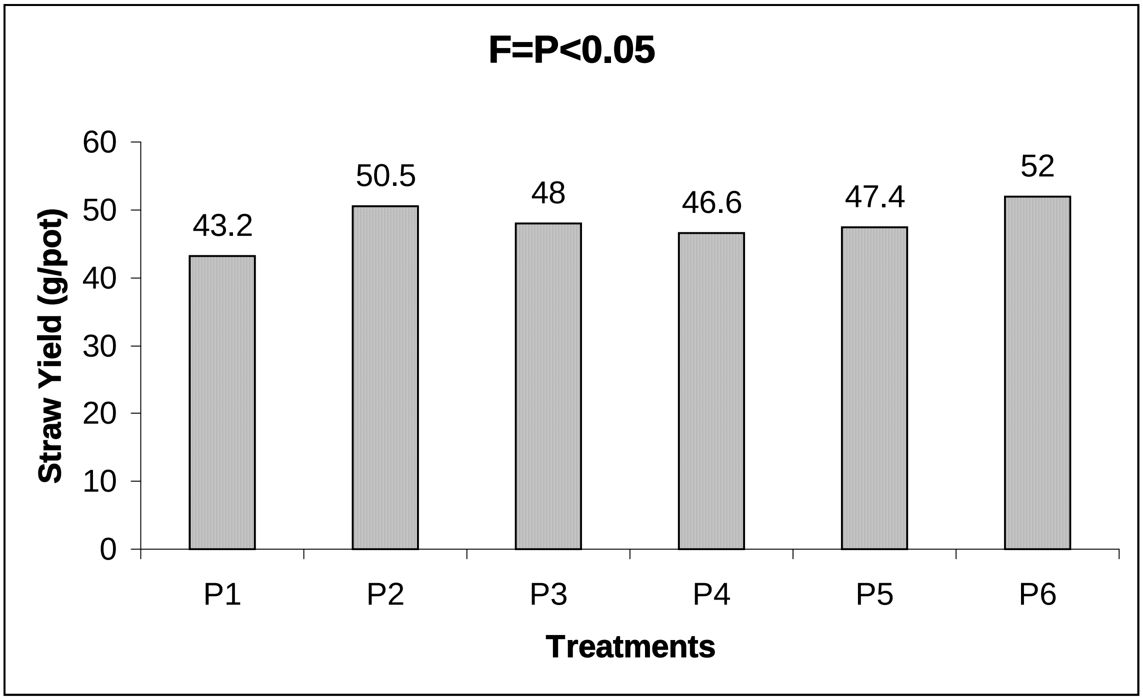

Fig. 16 : Graphical Representation of straw yield (g/pot) in the pot (Rice:NR 10414).

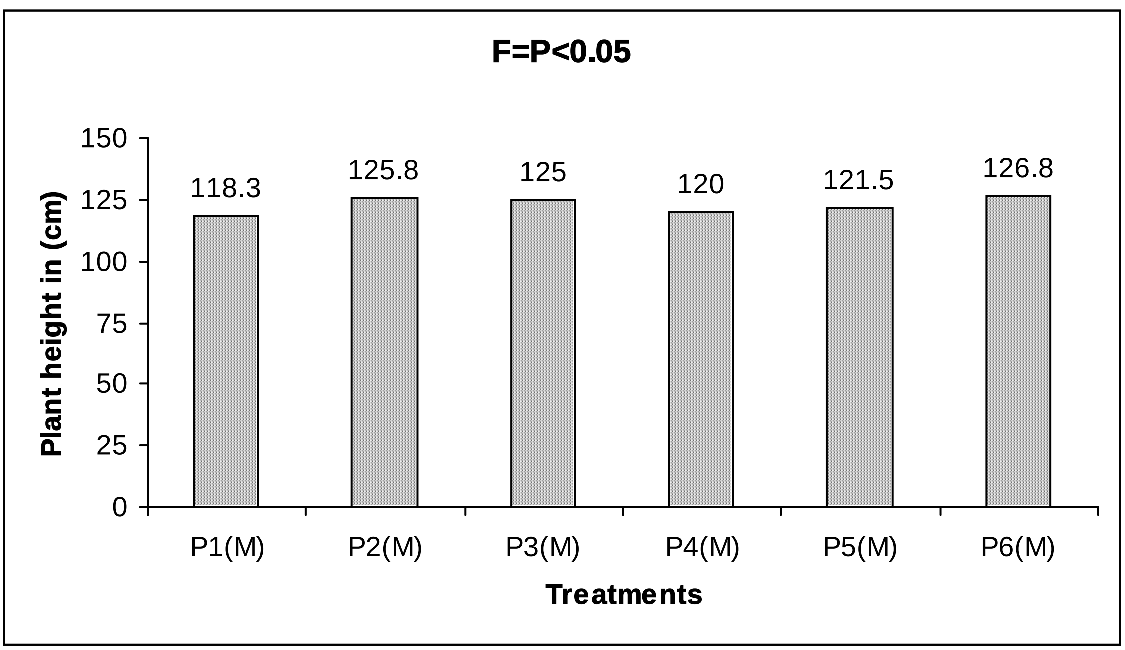

Fig. 17 : Graphical Representation of Plant height (cm) in the pot (Rice:Mansuli).

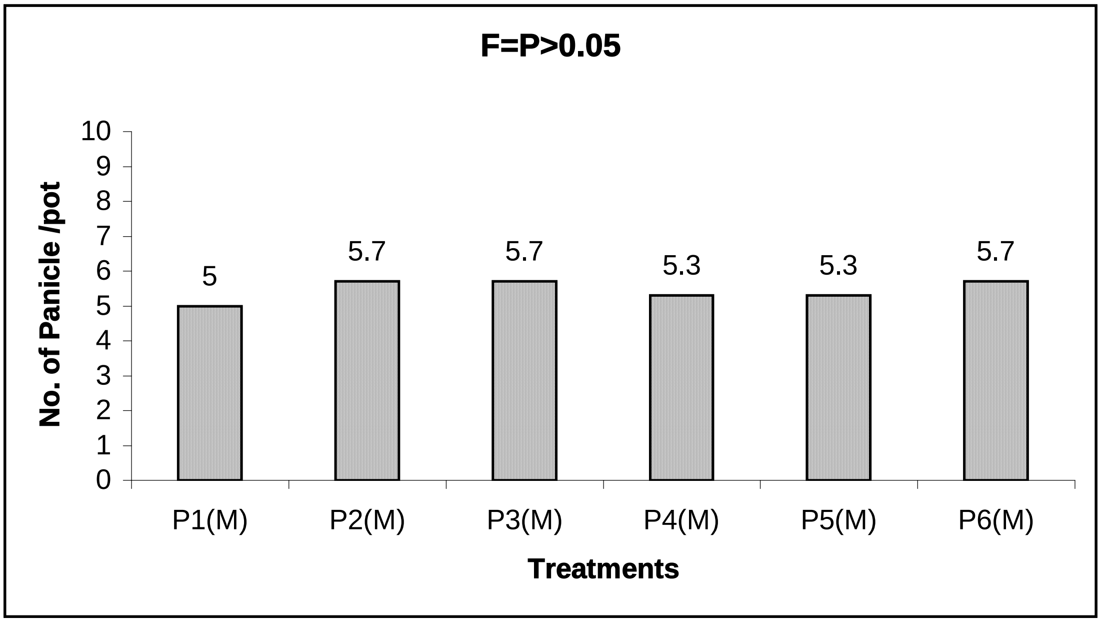

Fig. 18 : Graphical Representation of no. of panicles/pot in the pot (Rice:Mansuli).

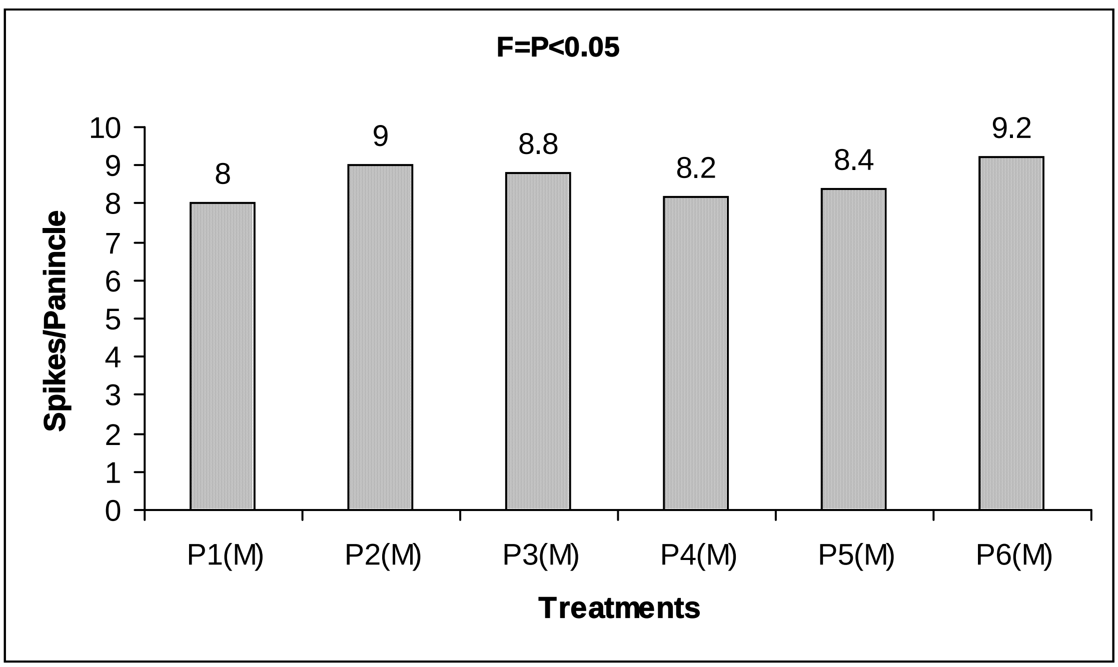

Fig. 19 : Graphical Representation of no. of spikes/panicle pot in the pot (Rice:Mansuli).

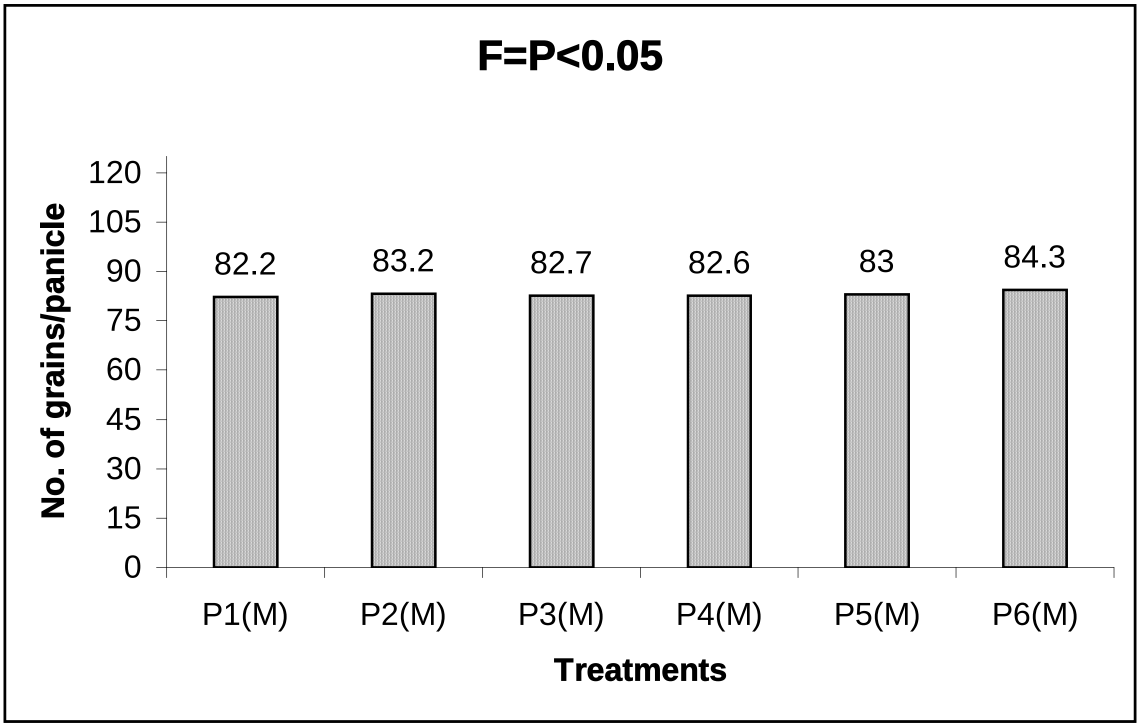

Fig. 20 : Graphical Representation of no. of grains/panicle pot in the pot (Rice:Mansuli).

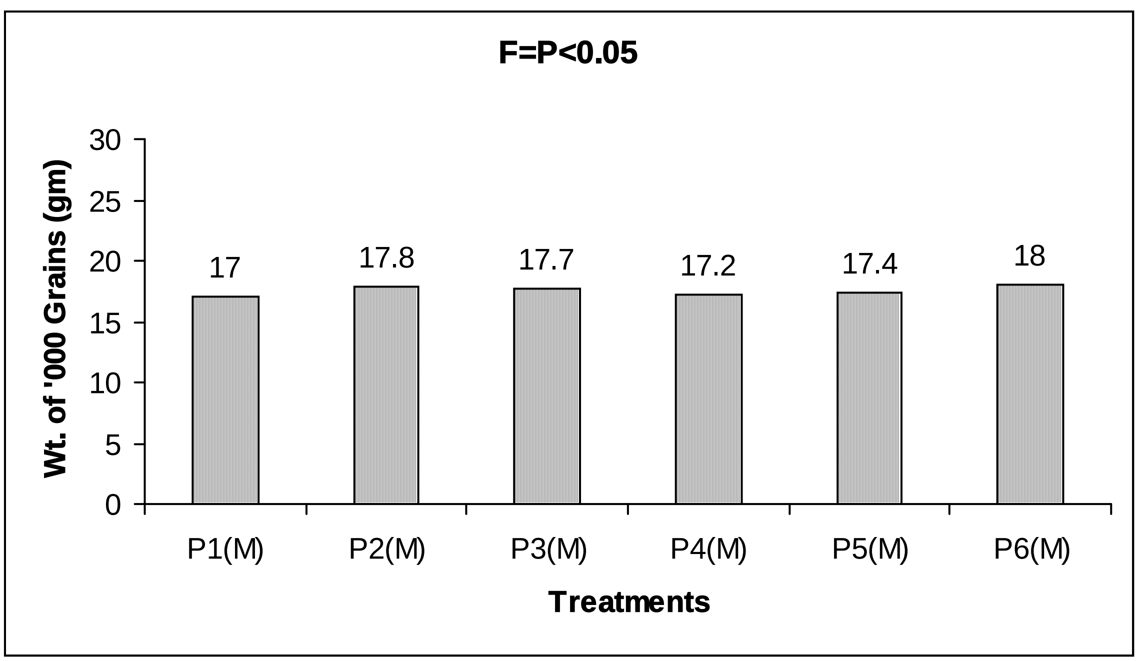

Fig. 21 : Graphical Representation of wt. of 1000 grains (gm) pot in the pot (Rice:Mansuli).

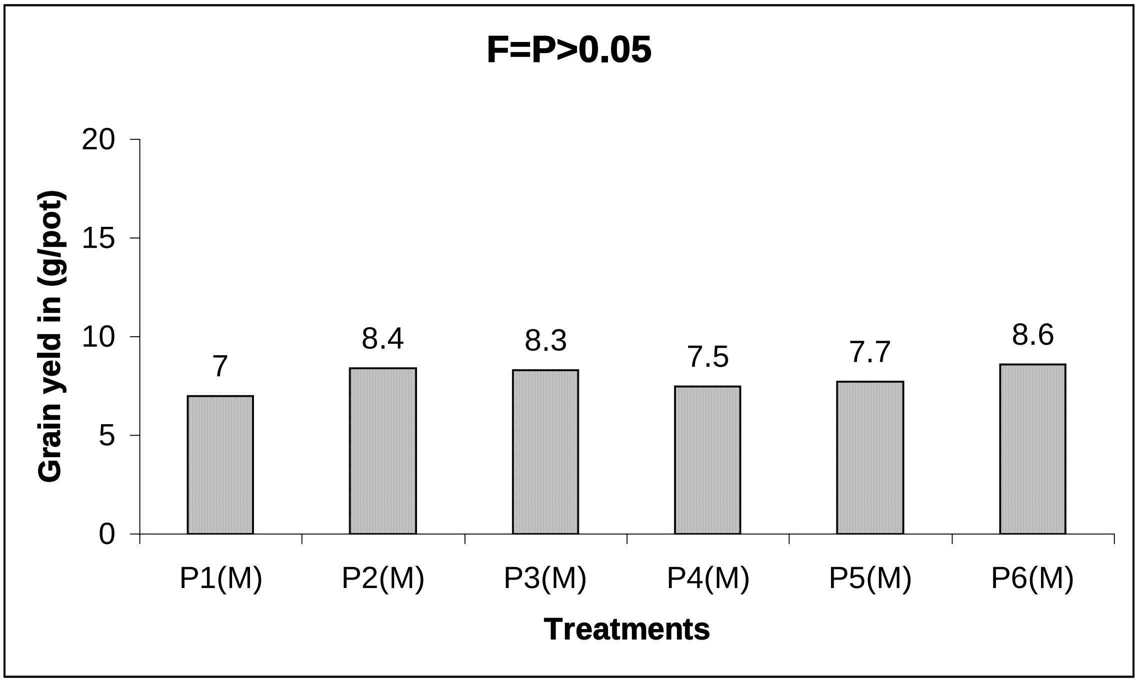

Fig. 22 : Graphical Representation of Grain yield in (g/pot) in the pot (Rice:Mansuli).

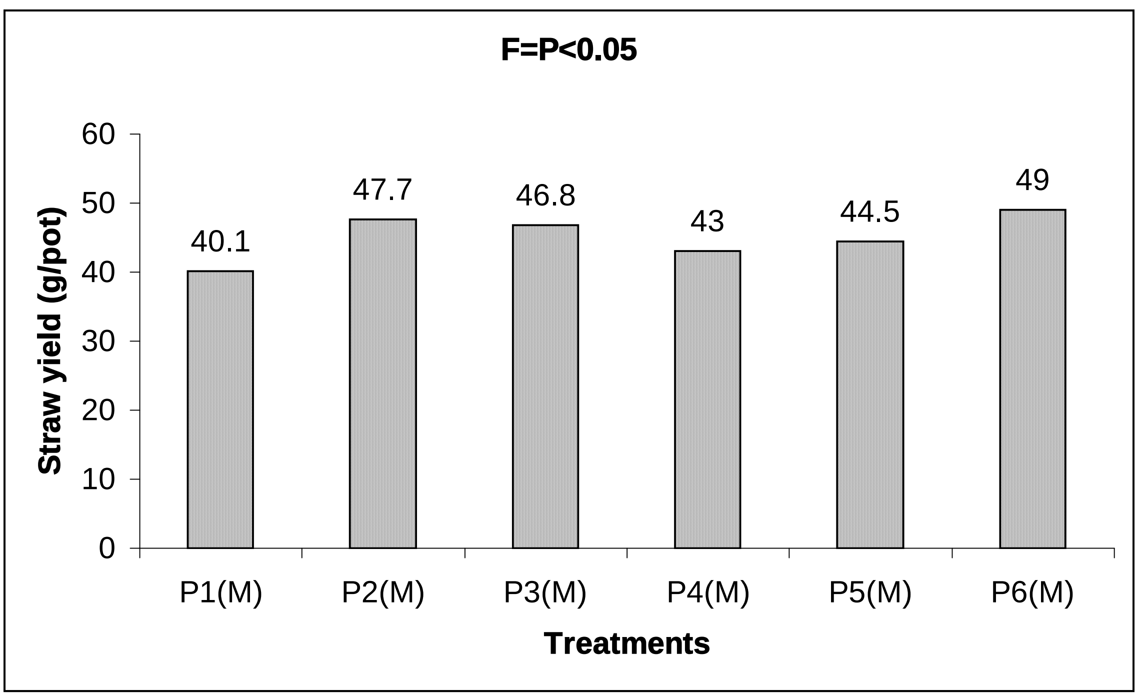

Fig. 23 : Graphical Representation of straw yield (g/pot) in the pot (Rice:Mansuli).

5.3 Results on the effect of BGA on the N and organic matter content of soil

Regarding the N-content in the soil, the least value was found in the control set. BGA showed considerable increase in N-content in the test samples. The highest N-content was found in the treatment containing BGA mixed inoculum in both the field and pot experiments. The maximum N content was found to be equal higher in NR 10414 than in mansuli in the same treatment in pot experiment.

The results of organic carbon revealed that due to incorporation of blue green algae in the pot cultured soils, resulted remarkable enhancement on the status of organic carbon content. However, the combine effect of BGA on NPK contributed more in the increment of organic carbon of the soil. The least amount of organic carbon was found in the control treatment. The maximum carbon content was found to be higher in rice mansuli than in NR 10414 in the same treatment in pot experiment.

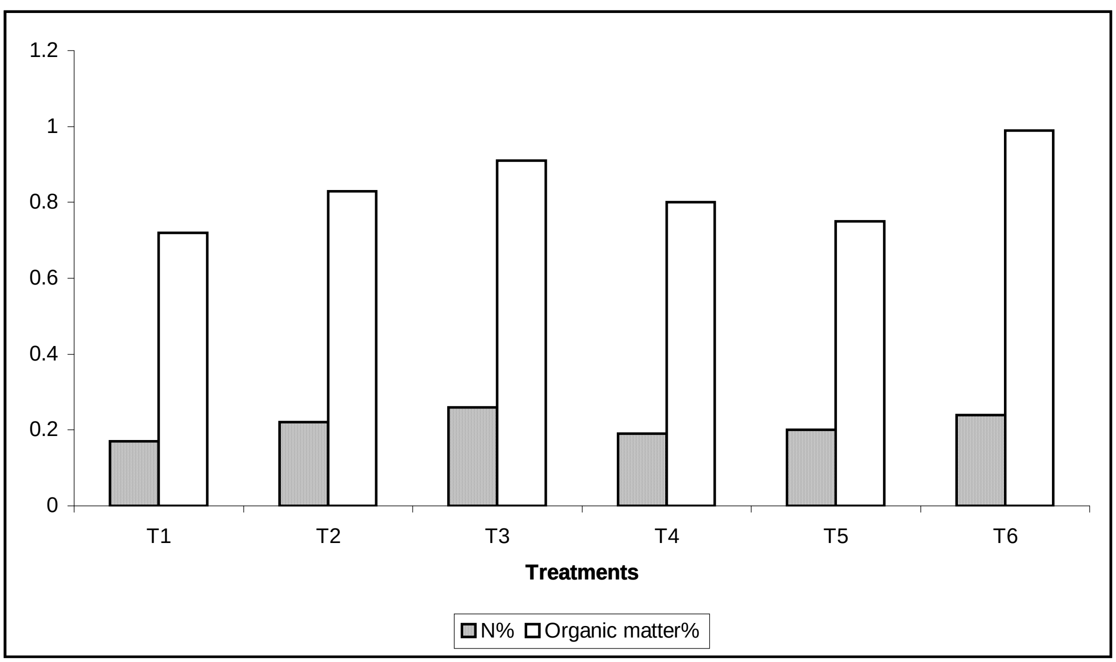

Fig. 24: Graphical Representation of N and organic matter content of field

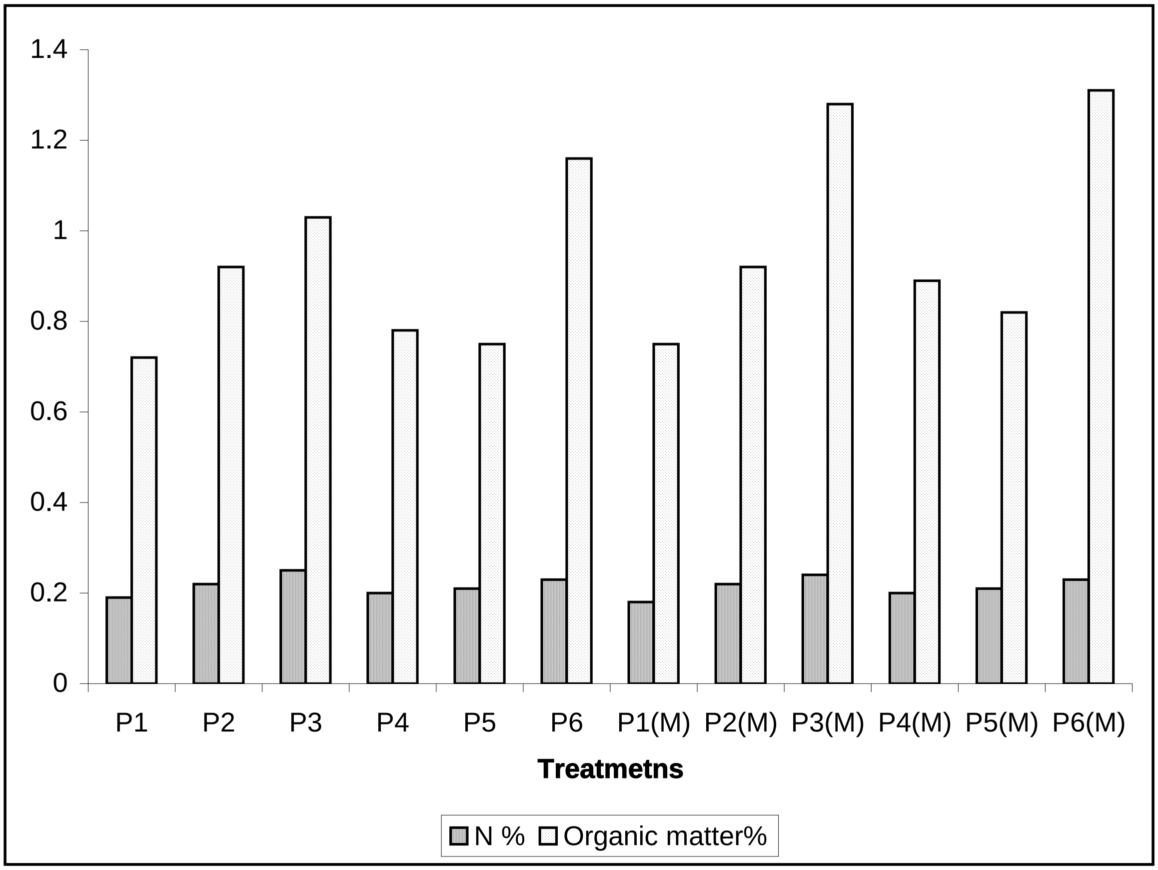

Fig. 25: Graphical Representation of N and organic matter content on pot.

5.4 Results on chlorophyll content of leaves of rice in pot experiment

Regarding the chlorophyll estimation of rice leaves in the pot experiment.,the highest amount of chlorophyll-a, chlorophyll-b and total chlorophylls were found in the treatments P6 and P6(M) in both the rice varieties. The least value was found in the controlled treatment in both rice varieties.The increase in chlorophyll a,chlorophyll b and total chlorophyll was 55.66%, 60.36% and 52.08% respectively in P6 of rice NR10414.Where as the increase was found to be 50.65%, 59.8%, and 51.94% in chlorophyll a,chlorophyll b and total chlorophyll respectively in rice Mansuli in the treatment P6(M) over controlled. Comparatively higher amount of chlorophylls was found in rice NR 10414 than in mansuli.

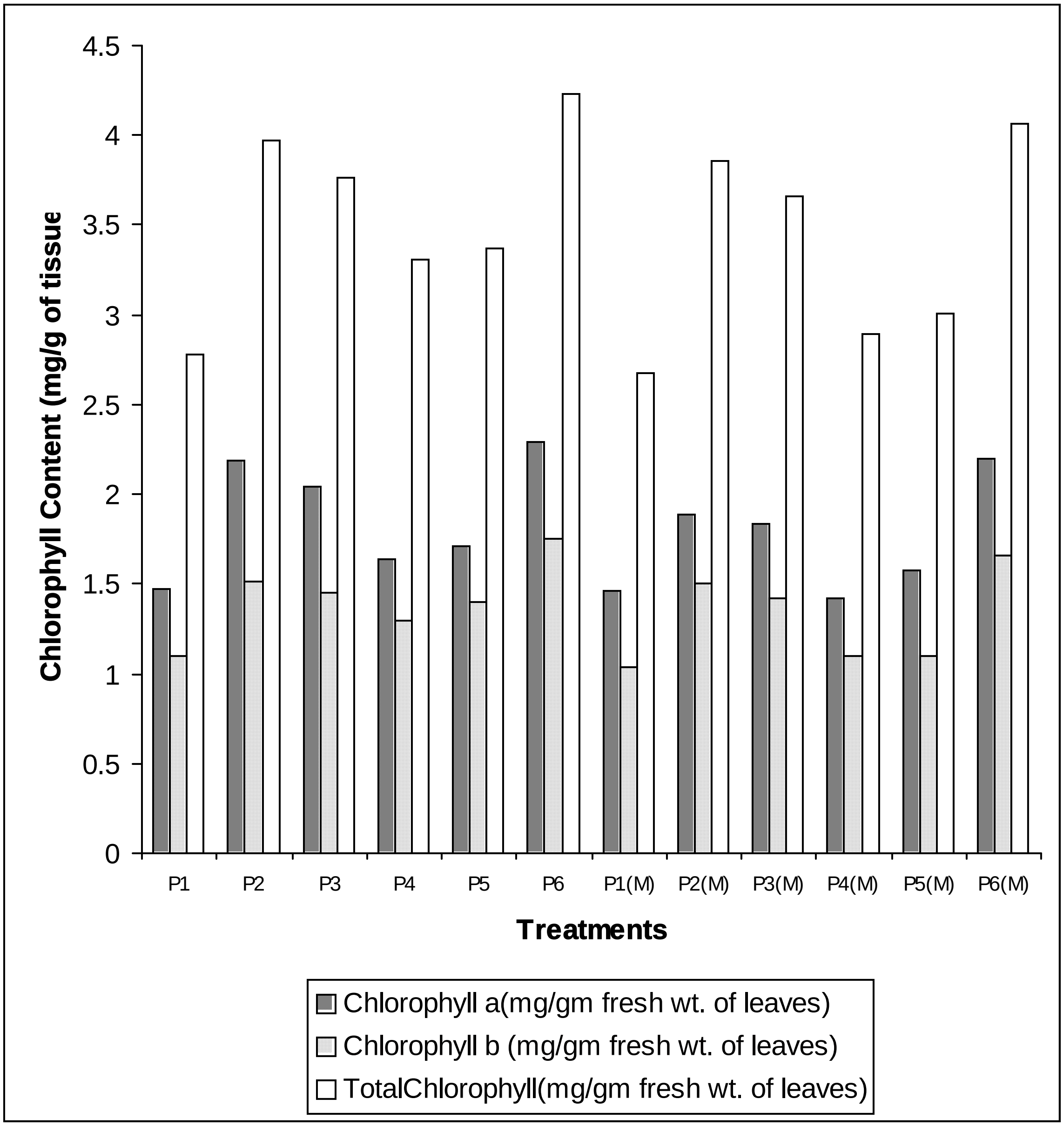

Fig. 26 Graphical Representation of the chlorophyll content of rice leaves of pot.

6. DISCUSSION

The role of BGA in supplying N to rice fields is well documented. In addition, they also bring about directly or indirectly, a number of changes in the physical, chemical and biological properties of soil and soil-water interface in rice fields. BGA liberate extracellular organic compounds and photosynthetic O_2 during their growth. They also contribute to biomass. The benefits of BGA from organic carbon addition are improvement in soil physical properties, retardation of NH_3 volatilisation loss, mobilisation of fixed phosphates, regulation of micronutrients particularly Fe, Mn and Zn, affecting their availability, supression of weeds and release of growth promoting substances. Sometimes outweigh those benefits due to the N-added by them. However, these can be achieved only if there is good growth of BGA in rice fields, but this doesn't always happen under natural conditions.

6.1 Discussion on the effect of NPK treatment on rice yield and yield parameters

The application of nitrogenous fertilizers could increase the yield of rice. Due to the inadequate supply of nutrients and low eficiency of the applied nitrogen, fertilizer gave the poor performance then combine with BGA. The split application of nitrogen might be due to the availability of nitrogen to the plant at the early stage and the later stages of rice plant as well as the supply of other nutrients i.e. phosphorous(P) and potassium(K).

Plants have to depend on the soil nitrogen if there was no N top dressing. In present experiment the yield increased was found to be 9.1 - 151%. The uptake of soil nitrogen was reported upto 66% (Dhyani and Mishra, 1993).

Researches have also reported that mineral fertilizers are easy to use and may give better yield but their continuous application reduces the fertility of soils, leads to serious environmental problems.

6.2 Discussion on the effect of BGA on rice yield and yield paramerers

The rice yield was found more in BGA treated sets than controlled sets. The grain yield and straw yields in field experiment were significant ($P<0.05$). Similarly the grain yield and straw yield were significant in pot experiment of rice NR 10414. The grain yield was not significant and the straw yield was significant in pot experiment of rice Mansuli. The extent of the poor yield potential of rice in the control plot was due to insufficiency of available N to the rice crop. While the maximum amount of grain and straw yield in the treatment with the combined effect of NPK and BGA was obviously due to the additional supply of N contributed by combined effect of chemical N and BGA.The used inoculum of *Nostoc*, *Anabaena*, *Weistollopsis*, *Aulosira* and *Scytonema* grew luxuriantly. The bulk of nitrogen fixed by cyanobacteria is probably released only in death and decay of cyanobacteria. The slow release of biologically fixed nitrogen is one of it's advantages in paddy soils. The grain yield increased by cyanobacteria in this research work ranged from 7.1% - 23.6% whereas increase in straw yield was ranged from 7.2% - 22.2% which is supported by the reports of other scientists. Vendam *et al*. (1999) reported 15-16% increased in rice yield by BGA inoculation. Similarly Prasad and Prasad (2003) reported yield increased by 5-24.1% from thier experiments conducted in three agricultural stations of Nepal. Mishra and Pabbi (2004) also found the yield increased by 12.3-19.5% on BGA inoculation in rice fields

6.3 Discussion on the effect of BGA on the N and organic matter content of soil

In control set, the less amount of nitrogen content of soil was probably due to insufficiency of source of nitrogen. In cyanobacteria (BGA) inoculated treatments, the soil nitrogen was found more. It was obviously due to an additional supply of nitrogen in soil by BGA. In water logging condition, the BGA multiplied, fixed atmospherric nitrogen (N_2) and released into the surrounding. Although there are varying records of BGA contributing different amount of nitrogen to crop fields as a result of their nitrogen fixing potentiality. It is generally believed that at least from 14kg-70kg N/ha (normally) from 20-30kg N/ha is contributed by nitogen fixing BGA which forms under the existing field conditions. In present experiment, the N content was found to be 0.26% by BGA inoculation. Gurung (2004) 5.26% increase in soil N due to BGA inoculation in rice field of Kathmandu.

The less amount of organic carbon in the control sets was due to insufficiency of organic carbon suppliers. The organic carbon was found more in the treatments with BGA. The BGA after their death and decay add their organic carbon content to the soil. In present experiment, the organic carbon was found to be 0.78-1.31% by BGA inoculation. Das et al. 1991 reported addition of 3.2-6.8 t/ha organic carbon by BGA. Algal inoculation increases the organic matter of soil (De and Suleman, 1950, Fuller and Roger 1952, Aiyer *et al* 1971a, Sankaram 1971, Osmanova 1979, Das *et al* 1991. The addition of organic carbon plays an important role for high production of rice. A well developed continuous layer of colonies of different species of BGA in rice field generally yields a significant amount of biomass. Roger and Kulasooriya (1980) and Roger *et al.* (1987) indicated that under favourable condition, a good algal bloom in rice fields yields on average about 6-8 ton (t) of fresh biomass. The persistence of such biomass in soil as organic matter, however depends on it's decomposability. The differing susceptibility of algae to decomposition is related to the relative biodegradability of algal cell wall compounds like polyaromatic compounds (Gunnison and Alexander, 1975) and their physiological growth stages. The higher amount of organic carbon in pot experiment in the same treatment in rice mansuli was due to the much decomposition of BGA in treatment P6 (M).

6.4 Discussion on the chlorophyll content of leaves of rice in pot experiment

The BGA treated sets experimentally showed more chlorophyll content than the sets without BGA. The highest amount of chlorophyll a, chlorophyll b and total chlorophyll was found in the treatment containing NPK(30:20:20) and BGA. As the BGA fixed atmospherric nitrogen, the amount of chlorophyll was also increased. It was found that the chlorophyll content was higher in all treatments than the control(fig. 26).It might be due to the avaibility of N in those treatments.

N requirement is very important for cereals. It is an established fact that plants as a whole try to maintain the ratio of C to N always one. If any of these two nutrients is less, the productivity is affected. If the N is less then the photosynthesis is also less, at this time the rice plant becomes yellow and this condition is called N-hunger. If any source of N is provided to the plant ,it changes to green. As the nitrogen is added by means of fertilizer chlorophyll also increases and the rate of photosynthesis increases, as a result of which the productivity of rice increases. The increased productivity by BGA inoculation was reported by different researchers (Yamamuro 1986, Kaushik 1995a, Prasad 2005). The higher amount of chlorophylls in rice NR

10414 was due to the supply of more nitrogen to this variety of rice than mansuli.

7. CONCLUSION

On the basis of present investigation, following conclusions have been made:

- Amongst six different combinations, the effect of treatment containing NPK (30:20:20) and BGA was found most effective in respect to grain and straw yield as well as yield parameters like plant height and 1000 grains weight. The increased in grain yield over control ranged from 7.1% to 23.6% whereas increase in straw yield was ranged from 7.2% to 22.2%.
- Even in the absence of chemical nitrogen, the application of BGA inoculum can increase the productivity of rice by 11.1%-19.1% when mixed inoculum of BGA was used.
- The single inoculum of *Anabaena sp.* increased the productivity of rice by 6.4% -7.9%.
- The total nitrogen content (N) of the soil was analyzed highest in treatment containing NPK (30:20:20) and BGA.
- In the areas of low organic matter, the use of BGA inoculation would be very helpful both in crop productivity and soil health management.
- The BGA help to increase the chlorophyll content of the rice.

8. RECOMMENDATIONS

The major recommendations of the present research work as follows:

- BGA should be used as biofertilizer to enhance the rice yield and soil fertility.
- Some indigenous nitrogen fixing BGA strains have been identified and remaining potential strains should be identified, isolated and their mass production for commercial use should be initiated.
- Tribhuvan University should have proper laboratory facilities.
- Tribhuvan University should have proper collaboration and joint venture with NARC, NAST, Department of Agriculture and other relevant agencies for BGA Biotechnology for sustainable agricultural and crop productivity in Nepal.

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APPENDIXES

Appendix I

a. The total monthly rainfall (mm), maximum temperature (°C) and minimum temperature (°C) of the representative meteorological station(Khokana) of Lalitpur, Nepal in the year 2005.

Months	Maximum Temp.°C	Minimum Temp.°C	Rainfall (mm)
January	16.5	2.5	79.4
February	20.4	3.4	15.0
March	23.6	7.5	59.4
April	27.0	8.5	55.9
May	28.2	12.7	88.5
June	29.7	17.5	160.3
July	27.9	20.3	216.8
August	27.5	20.2	276.4
September	28.5	18.5	115.3
October	25.7	12.0	115.3
November	22.5	5.5	0
December	19.9	0.7	0

b. The total monthly rainfall (mm), maximum temperature (°C) and minimum temperature (°C) of the representative meteorological station(Airport) of Kathmandu, Nepal in the year 2005.

Months	Maximum Temp.°C	Minimum Temp.°C	Rainfall (mm)
January	17.9	4.3	55.1
February	22.0	5.9	17.0
March	25.8	10.1	50.1
April	28.6	11.6	34.8
May	29.4	14.9	40.6
June	30.5	19.2	222.9
July	29.1	20.6	253.5
August	29.0	20.6	309.3
September	29.5	19.5	126.5
October	26.4	14.0	126.1
November	23.3	8.4	0
December	21.0	3.5	0

Appendix II

Morphological characters of the Blue green algae used in the experiment (Desikachary 1959).

***Nostoc* sp.**

Thallus mucilaginous, gelatinous or coriaceous first globose to oblong, later globose, foliose, filiform, bullose, solid or hollow free or attached, the periphery dense and darkly coloured, filaments flexuous, cured or entangled, sheath sometimes distinct, generally diffluent, trichome torulose cells depressed, spherical, barrel shaped or cylindricl heterocysts intercalary and in young condition terminal, spores spherical or oblong, formed centrifugally in series in between the heterocysts.

***Anabaena* sp.**

Trichomes uniformly broad throughout or apices alone somewhat attenulated, sheath absent or more or less diffluent, forming a free, torn or floccose or soft mucilaginous thallus, heterocysts generally intercalary, spores single or in long series, formed near the heterocysts or in between the heterocyst.

***Westiellopsis* sp.**

Thallus filamentous, with true branching filments of two kinds, primary filaments slightly thicker and more or less creeping, secondary filaments generally thinner and growing erect, filaments without a sheath and consisting of a single row of cells, heterocyst intercalary, the dilated terminal portions of secondary branches by profuse transverse and longitudinal divisions forming chains of rounded cells (Pseudo hormocysts), the contents escaping as gonidia (endospores) and develop as into new plants.

***Aulosira* sp.**

Filaments free, sparse or in fascicles, generally uniformly broad, without differentation of base and apex, trichomes with sheath, indefinite, heterocysts intercalary, spores often in series, formed near a heterocyst or away from it, cylindrical.

***Scytonema* sp.**

Filaments false branched, false branches single or geminate, formed laterally generally in between heterocysts, trichomes single in each sheath, straight, hormogones terminal, solitary, pseudo-hormogonia present, spores known only in a few species, spherical or ovate, exospare thin and smooth.

a. Effect of BGA on the rice Yield and Yield Parameters in the field (NR10414)

Treat-ments	Plant height (cm)	Panicles /hill	Spikes / panicle	No.of grains/ panicle	Wt.of 1000 grains (gm)	Grain Yield (t/ha)	% increase	Straw yield (t/ha)	% increase
T_1	137.8	8.5	8.8	114.8	20.2	8.6	100	8.3	100
T_2	148	9	9.2	116.3	21.2	9.7	112.8	9.6	115.1
T_3	143	8.9	9.1	117.2	21.7	9.9	115.1	9.5	114.5
T_4	138.5	8.7	8.9	115.8	20.8	9.2	107	8.9	107.2
T_5	140	8.8	9	116	21	9.4	109.3	9.3	112
T_6	150.2	9.1	9.5	118	22	10.3	120.9	9.8	118.1
GM	142.9	8.8	9.1	116.4	21.2	9.5		9.2	
CV(%)	3.67	5.45	4.73	2.52	3.16	6.21		5.98	
F-test	**	ns	ns	ns	*	**		**	

**Highly significant *Significant ns Not significant

b. Effect of BGA on the rice Yield and Yield Parameters in the Pot(NR10414)

Treat-ments	Plant height(cm)	Panicles /pot	Spikes /panicle	No.of grains/ panicle	Wt.of 1000 grains (gm)	Grain Yield (g/pot)	% increase	Straw Yield (g/pot)	% increase
P_1	134.2	6	8.4	105.3	17.4	11	100	43.2	100
P_2	140	6.7	9.8	109.2	18.2	13.3	120.9	50.5	106.9
P_3	138.6	6.7	9.5	109	18	13.1	119.1	48	111.1
P_4	135.6	6.3	8.1	106	17.5	11.7	106.4	46.6	107.9
P_5	137	6.3	8.5	106.7	17.8	12	109.1	47.4	109.2
P_6	143.3	6.7	10	110	18.5	13.6	123.6	52	120.4
GM	138.1	6.5	9.1	107.7	17.9	12.5		48	
CV(%)	2.43	7.8	8.8	1.83	2.8	10.08		6.19	

F-test	**	ns	**	**	*	*		**	

**Highly significant *Significant ns Not significant

c. Effect of BGA on the rice Yield and Yield Parameters in the Pot (Mansuli)

Treat-ments	Plant height(cm)	Panicles / pot	Spikes/ panicle	No.of grains/ panicle	Wt.of 1000 grains (gm)	Grain Yield (g/pot)	% increase	Straw Yield (g/pot)	% increase
$P_{1(M)}$	118.3	5	8	82.2	17	7	100	40.1	100
$P_{2(M)}$	125.8	5.7	9	83.2	17.8	8.4	120	47.7	119
$P_{3(M)}$	125	5.7	8.8	82.7	17.7	8.3	118.6	46.8	116.7
$P_{4(M)}$	120	5.3	8.2	82.6	17.2	7.5	107.1	43	107.2
$P_{5(M)}$	121.5	5.3	8.4	83	17.4	7.7	110	44.5	111
$P_{6(M)}$	126.8	5.7	9.2	84.3	18	8.6	122.9	49	122.2
GM	122.9	5.5	8.6	83	17.5	7.9		45.2	
CV(%)	2.8	9.27	6.63	.98	2.69	10.25		6.95	
F-test	**	ns	*	**	*	ns		**	

** Highly significant *Significant ns Not significant

Appendix III

a. Effect of BGA in the N and organic matter content of soil of field experiment.

Treatments	N%	Organic matter%
T_1	0.17	0.72
T_2	0.22	0.83
T_3	0.26	0.91
T_4	0.19	0.80
T_5	0.20	0.75
T_6	0.24	0.99

b. Effect of BGA in the N and organic matter content of soil of Pot experiment.

Treatments	N %	Organic matter%
P1	0.19	0.72
P2	0.22	0.92
P3	0.25	1.03
P4	0.20	0.78
P5	0.21	0.75
P6	0.23	1.16
P1(M)	0.18	0.75
P2(M)	0.22	0.92
P3(M)	0.24	1.28
P4(M)	0.20	0.89
P5(M)	0.21	0.82

P6(M)	0.23	1.31

c. Effect of BGA on chlorophyll content of leaves of rice in pot experiment

Treatments	Chlorophyll a(mg/gm fresh wt. of leaves)	Chlorophyll b (mg/gm fresh wt. of leaves)	TotalChlorophyll(mg/gm fresh wt. of leaves)
P1	1.475	1.095	2.782
P2	2.188	1.515	3.976
P3	2.041	1.447	3.768
P4	1.641	1.291	3.304
P5	1.716	1.400	3.373
P6	2.296	1.756	4.231
P1(M)	1.457	1.040	2.678
P2(M)	1.888	1.503	3.860
P3(M)	1.835	1.417	3.663
P4(M)	1.416	1.099	2.898
P5(M)	1.576	1.101	3.002
P6(M)	2.195	1.662	4.069

Appendix IV
Analysis of Variance(ANOVA) for plant height(cm) in the field Rice-NR10414)

Source of variation	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	399.265	5	79.853	13.666	.000
Within Groups	70.120	12	5.843		
Total	469.385	17			

LSD Multiple comparision of means on dependant variable Plant height

Treatment (I)	Treatment (J)	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1.00	2.00	-10.20000(*)	1.97372	.000	-14.5004	-5.8996
	3.00	-5.20000(*)	1.97372	.022	-9.5004	-.8996
	4.00	-.70000	1.97372	.729	-5.0004	3.6004
	5.00	-2.20000	1.97372	.287	-6.5004	2.1004
	6.00	-12.40000(*)	1.97372	.000	-16.7004	-8.0996
2.00	1.00	10.20000(*)	1.97372	.000	5.8996	14.5004
	3.00	5.00000(*)	1.97372	.026	.6996	9.3004
	4.00	9.50000(*)	1.97372	.000	5.1996	13.8004
	5.00	8.00000(*)	1.97372	.002	3.6996	12.3004
	6.00	-2.20000	1.97372	.287	-6.5004	2.1004
3.00	1.00	5.20000(*)	1.97372	.022	.8996	9.5004
	2.00	-5.00000(*)	1.97372	.026	-9.3004	-.6996
	4.00	4.50000(*)	1.97372	.042	.1996	8.8004
	5.00	3.00000	1.97372	.154	-1.3004	7.3004
	6.00	-7.20000(*)	1.97372	.003	-11.5004	-2.8996
4.00	1.00	.70000	1.97372	.729	-3.6004	5.0004
	2.00	-9.50000(*)	1.97372	.000	-13.8004	-5.1996
	3.00	-4.50000(*)	1.97372	.042	-8.8004	-.1996
	5.00	-1.50000	1.97372	.462	-5.8004	2.8004
	6.00	-11.70000(*)	1.97372	.000	-16.0004	-7.3996
5.00	1.00	2.20000	1.97372	.287	-2.1004	6.5004
	2.00	-8.00000(*)	1.97372	.002	-12.3004	-3.6996
	3.00	-3.00000	1.97372	.154	-7.3004	1.3004
	4.00	1.50000	1.97372	.462	-2.8004	5.8004
	6.00	-10.20000(*)	1.97372	.000	-14.5004	-5.8996
6.00	1.00	12.40000(*)	1.97372	.000	8.0996	16.7004
	2.00	2.20000	1.97372	.287	-2.1004	6.5004
	3.00	7.20000(*)	1.97372	.003	2.8996	11.5004

	4.00	11.70000(*)	1.97372	.000	7.3996	16.0004
	5.00	10.20000(*)	1.97372	.000	5.8996	14.5004

* The mean difference is significant at the .05 level

APPENDIX V

Analysis of Variance(ANOVA)for no.of panicles/hill in the field.(Rice-NR10414)

Source of variation	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	.784	5	.157	.603	.699
Within Groups	3.120	12	.260		
Total	3.904	17			

LSD Multiple comparision of means on dependant variable Panicles/hill

Treatment (I)	Treatment (J)	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1.00	2.00	-.46667	.41633	.284	-1.3738	.4404
	3.00	-.33333	.41633	.439	-1.2404	.5738
	4.00	-.20000	.41633	.640	-1.1071	.7071
	5.00	-.26667	.41633	.534	-1.1738	.6404
	6.00	-.66667	.41633	.135	-1.5738	.2404
2.00	1.00	.46667	.41633	.284	-.4404	1.3738
3.00	.13333	.41633	.754	-.7738	1.0404	
4.00	.26667	.41633	.534	-.6404	1.1738	
5.00	.20000	.41633	.640	-.7071	1.1071	
6.00	-.20000	.41633	.640	-1.1071	.7071	
3.00	1.00	.33333	.41633	.439	-.5738	1.2404
2.00	-.13333	.41633	.754	-1.0404	.7738	
4.00	.13333	.41633	.754	-.7738	1.0404	
5.00	.06667	.41633	.875	-.8404	.9738	
6.00	-.33333	.41633	.439	-1.2404	.5738	

4.00	1.00	.20000	.41633	.640	-.7071	1.1071
2.00	-.26667	.41633	.534	-1.1738	.6404	
3.00	-.13333	.41633	.754	-1.0404	.7738	
5.00	-.06667	.41633	.875	-.9738	.8404	
6.00	-.46667	.41633	.284	-1.3738	.4404	
5.00	1.00	.26667	.41633	.534	-.6404	1.1738
2.00	-.20000	.41633	.640	-1.1071	.7071	
3.00	-.06667	.41633	.875	-.9738	.8404	
4.00	.06667	.41633	.875	-.8404	.9738	
6.00	-.40000	.41633	.356	-1.3071	.5071	
6.00	1.00	.66667	.41633	.135	-.2404	1.5738
2.00	.20000	.41633	.640	-.7071	1.1071	
3.00	.33333	.41633	.439	-.5738	1.2404	
4.00	.46667	.41633	.284	-.4404	1.3738	
5.00	.40000	.41633	.356	-.5071	1.3071	

* The mean difference is significant at the .05 level

APPENDIX VI

Analysis of Variance(ANOVA)for no.of spikes per panicles in the field (Rice-NR10414.

Source of variation	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	.793	5	.159	.811	.564
Within Groups	2.347	12	.196		
Total	3.140	17			

LSD Multiple comparision of means on dependant variable Spikes/Panicle

Treatment (I)	Treatment (J)	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1.00	2.00	-.40000	.36107	.290	-1.1867	.3867
	3.00	-.33333	.36107	.374	-1.1200	.4534
	4.00	-.13333	.36107	.718	-.9200	.6534
	5.00	-.26667	.36107	.474	-1.0534	.5200
	6.00	-.66667	.36107	.090	-1.4534	.1200
2.00	1.00	.40000	.36107	.290	-.3867	1.1867
3.00	.06667	.36107	.857	-.7200	.8534	
4.00	.26667	.36107	.474	-.5200	1.0534	
5.00	.13333	.36107	.718	-.6534	.9200	
6.00	-.26667	.36107	.474	-1.0534	.5200	
3.00	1.00	.33333	.36107	.374	-.4534	1.1200
2.00	-.06667	.36107	.857	-.8534	.7200	
4.00	.20000	.36107	.590	-.5867	.9867	
5.00	.06667	.36107	.857	-.7200	.8534	
6.00	-.33333	.36107	.374	-1.1200	.4534	
4.00	1.00	.13333	.36107	.718	-.6534	.9200
2.00	-.26667	.36107	.474	-1.0534	.5200	

3.00	-.20000	.36107	.590	-.9867	.5867	
5.00	-.13333	.36107	.718	-.9200	.6534	
6.00	-.53333	.36107	.165	-1.3200	.2534	
5.00	1.00	.26667	.36107	.474	-.5200	1.0534
2.00	-.13333	.36107	.718	-.9200	.6534	
3.00	-.06667	.36107	.857	-.8534	.7200	
4.00	.13333	.36107	.718	-.6534	.9200	
6.00	-.40000	.36107	.290	-1.1867	.3867	
6.00	1.00	.66667	.36107	.090	-.1200	1.4534
2.00	.26667	.36107	.474	-.5200	1.0534	
3.00	.33333	.36107	.374	-.4534	1.1200	
4.00	.53333	.36107	.165	-.2534	1.3200	
5.00	.40000	.36107	.290	-.3867	1.1867	

* The mean difference is significant at the .05 level

APPENDIX VII

Analysis of Variance(ANOVA)for no.of grains per panicle in the field. (Rice-NR10414

Source of variation	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	18.840	5	3.768	.355	.869
Within Groups	127.320	12	10.610		
Total	146.160	17			

LSD Multiple comparision of means on dependant variable No.of grains/Panicle

Treatment (I)	Treatment (J)	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
1.00	2.00	-1.46667	2.65957	.591	-7.2614	4.3280
	3.00	-2.36667	2.65957	.391	-8.1614	3.4280
	4.00	-1.00000	2.65957	.713	-6.7947	4.7947
	5.00	-1.00000	2.65957	.713	-6.7947	4.7947
	6.00	-3.16667	2.65957	.257	-8.9614	2.6280
2.00	1.00	1.46667	2.65957	.591	-4.3280	7.2614
3.00	-.90000	2.65957	.741	-6.6947	4.8947	
4.00	.46667	2.65957	.864	-5.3280	6.2614	
5.00	.46667	2.65957	.864	-5.3280	6.2614	
6.00	-1.70000	2.65957	.535	-7.4947	4.0947	
3.00	1.00	2.36667	2.65957	.391	-3.4280	8.1614
2.00	.90000	2.65957	.741	-4.8947	6.6947	
4.00	1.36667	2.65957	.617	-4.4280	7.1614	
5.00	1.36667	2.65957	.617	-4.4280	7.1614	
6.00	-.80000	2.65957	.769	-6.5947	4.9947	
4.00	1.00	1.00000	2.65957	.713	-4.7947	6.7947

2.00	-.46667	2.65957	.864	-6.2614	5.3280	
3.00	-1.36667	2.65957	.617	-7.1614	4.4280	
5.00	.00000	2.65957	1.000	-5.7947	5.7947	
6.00	-2.16667	2.65957	.431	-7.9614	3.6280	
5.00	1.00	1.00000	2.65957	.713	-4.7947	6.7947
2.00	-.46667	2.65957	.864	-6.2614	5.3280	
3.00	-1.36667	2.65957	.617	-7.1614	4.4280	
4.00	.00000	2.65957	1.000	-5.7947	5.7947	
6.00	-2.16667	2.65957	.431	-7.9614	3.6280	
6.00	1.00	3.16667	2.65957	.257	-2.6280	8.9614
2.00	1.70000	2.65957	.535	-4.0947	7.4947	
3.00	.80000	2.65957	.769	-4.9947	6.5947	
4.00	2.16667	2.65957	.431	-3.6280	7.9614	
5.00	2.16667	2.65957	.431	-3.6280	7.9614	

* The mean difference is significant at the .05 level

APPENDIX VIII

Analysis of Variance(ANOVA)for wt.of 1000 grains(gm) in the field. (Rice-NR10414

Source of variation	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	4.803	5	.961	4.166	.020
Within Groups	2.767	12	.231		
Total	7.569	17			

LSD Multiple comparision of means on dependant variable Wt. of 1000 grains

Treatment (I)	Treatment (J)	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1.00	2.00	-1.00000(*)	.39205	.025	-1.8542	-.1458
	3.00	-1.50000(*)	.39205	.002	-2.3542	-.6458
	4.00	-.60000	.39205	.152	-1.4542	.2542
	5.00	-.80000	.39205	.064	-1.6542	.0542
	6.00	-1.46667(*)	.39205	.003	-2.3209	-.6125
2.00	1.00	1.00000(*)	.39205	.025	.1458	1.8542
	3.00	-.50000	.39205	.226	-1.3542	.3542
	4.00	.40000	.39205	.328	-.4542	1.2542
	5.00	.20000	.39205	.619	-.6542	1.0542
	6.00	-.46667	.39205	.257	-1.3209	.3875
3.00	1.00	1.50000(*)	.39205	.002	.6458	2.3542
	2.00	.50000	.39205	.226	-.3542	1.3542
	4.00	.90000(*)	.39205	.041	.0458	1.7542
	5.00	.70000	.39205	.099	-.1542	1.5542
	6.00	.03333	.39205	.934	-.8209	.8875
4.00	1.00	.60000	.39205	.152	-.2542	1.4542
	2.00	-.40000	.39205	.328	-1.2542	.4542
	3.00	-.90000(*)	.39205	.041	-1.7542	-.0458
	5.00	-.20000	.39205	.619	-1.0542	.6542
	6.00	-.86667(*)	.39205	.047	-1.7209	-.0125
5.00	1.00	.80000	.39205	.064	-.0542	1.6542
	2.00	-.20000	.39205	.619	-1.0542	.6542
	3.00	-.70000	.39205	.099	-1.5542	.1542
	4.00	.20000	.39205	.619	-.6542	1.0542
	6.00	-.66667	.39205	.115	-1.5209	.1875
6.00	1.00	1.46667(*)	.39205	.003	.6125	2.3209
	2.00	.46667	.39205	.257	-.3875	1.3209

	3.00	-.03333	.39205	.934	-.8875	.8209
	4.00	.86667(*)	.39205	.047	.0125	1.7209
	5.00	.66667	.39205	.115	-.1875	1.5209

* The mean difference is significant at the .05 level

APPENDIX IX

Analysis of Variance(ANOVA)for grain yield(t/ha) in the field (Rice-NR10414.

Source of variation	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	4.911	5	.982	13.000	.000
Within Groups	.907	12	.076		
Total	5.818	17			

LSD Multiple comparision of means on dependant variable Grain yield(t/ha)

Treatment (I)	Treatment (J)	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1.00	2.00	-1.03333(*)	.22443	.001	-1.5223	-.5443
	3.00	-1.20000(*)	.22443	.000	-1.6890	-.7110
	4.00	-.50000(*)	.22443	.046	-.9890	-.0110
	5.00	-.70000(*)	.22443	.009	-1.1890	-.2110
	6.00	-1.63333(*)	.22443	.000	-2.1223	-1.1443
2.00	1.00	1.03333(*)	.22443	.001	.5443	1.5223
	3.00	-.16667	.22443	.472	-.6557	.3223
	4.00	.53333(*)	.22443	.035	.0443	1.0223
	5.00	.33333	.22443	.163	-.1557	.8223
	6.00	-.60000(*)	.22443	.020	-1.0890	-.1110
3.00	1.00	1.20000(*)	.22443	.000	.7110	1.6890
	2.00	.16667	.22443	.472	-.3223	.6557
	4.00	.70000(*)	.22443	.009	.2110	1.1890
	5.00	.50000(*)	.22443	.046	.0110	.9890
	6.00	-.43333	.22443	.077	-.9223	.0557
4.00	1.00	.50000(*)	.22443	.046	.0110	.9890
	2.00	-.53333(*)	.22443	.035	-1.0223	-.0443
	3.00	-.70000(*)	.22443	.009	-1.1890	-.2110
	5.00	-.20000	.22443	.390	-.6890	.2890
	6.00	-1.13333(*)	.22443	.000	-1.6223	-.6443
5.00	1.00	.70000(*)	.22443	.009	.2110	1.1890
	2.00	-.33333	.22443	.163	-.8223	.1557
	3.00	-.50000(*)	.22443	.046	-.9890	-.0110

	4.00	.20000	.22443	.390	-.2890	.6890
	6.00	-.93333(*)	.22443	.001	-1.4223	-.4443
6.00	1.00	1.63333(*)	.22443	.000	1.1443	2.1223
	2.00	.60000(*)	.22443	.020	.1110	1.0890
	3.00	.43333	.22443	.077	-.0557	.9223
	4.00	1.13333(*)	.22443	.000	.6443	1.6223
	5.00	.93333(*)	.22443	.001	.4443	1.4223

* The mean difference is significant at the .05 level

APPENDIX X

Analysis of Variance(ANOVA)for straw yield(t/ha) in the field (Rice-NR10414.

Source of variation	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	4.856	5	.971	58.273	.000
Within Groups	.200	12	.017		
Total	5.056	17			

LSD Multiple comparision of means on dependant variable Straw yield(t/ha) .(Rice variety-NR10414

Treatment (I)	Treatment (J)	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1.00	2.00	-1.33333(*)	.10541	.000	-1.5630	-1.1037
	3.00	-1.26667(*)	.10541	.000	-1.4963	-1.0370
	4.00	-.60000(*)	.10541	.000	-.8297	-.3703
	5.00	-1.03333(*)	.10541	.000	-1.2630	-.8037
	6.00	-1.53333(*)	.10541	.000	-1.7630	-1.3037
2.00	1.00	1.33333(*)	.10541	.000	1.1037	1.5630
	3.00	.06667	.10541	.539	-.1630	.2963
	4.00	.73333(*)	.10541	.000	.5037	.9630
	5.00	.30000(*)	.10541	.015	.0703	.5297
	6.00	-.20000	.10541	.082	-.4297	.0297
3.00	1.00	1.26667(*)	.10541	.000	1.0370	1.4963
	2.00	-.06667	.10541	.539	-.2963	.1630
	4.00	.66667(*)	.10541	.000	.4370	.8963
	5.00	.23333(*)	.10541	.047	.0037	.4630
	6.00	-.26667(*)	.10541	.026	-.4963	-.0370
4.00	1.00	.60000(*)	.10541	.000	.3703	.8297
	2.00	-.73333(*)	.10541	.000	-.9630	-.5037
	3.00	-.66667(*)	.10541	.000	-.8963	-.4370
	5.00	-.43333(*)	.10541	.001	-.6630	-.2037
	6.00	-.93333(*)	.10541	.000	-1.1630	-.7037

5.00	1.00	1.03333(*)	.10541	.000	.8037	1.2630
	2.00	-.30000(*)	.10541	.015	-.5297	-.0703
	3.00	-.23333(*)	.10541	.047	-.4630	-.0037
	4.00	.43333(*)	.10541	.001	.2037	.6630
	6.00	-.50000(*)	.10541	.000	-.7297	-.2703
6.00	1.00	1.53333(*)	.10541	.000	1.3037	1.7630
	2.00	.20000	.10541	.082	-.0297	.4297
	3.00	.26667(*)	.10541	.026	.0370	.4963
	4.00	.93333(*)	.10541	.000	.7037	1.1630
	5.00	.50000(*)	.10541	.000	.2703	.7297

* The mean difference is significant at the .05 level

APPENDIX XI

Analysis of Variance(ANOVA) for plant height(cm) in the pot(Rice-NR10414)

Source of variation	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	160.705	5	32.141	12.426	.000
Within Groups	31.040	12	2.587		
Total	191.745	17			

Multiple LSD comparision of means on dependant variable Plant height(cm).

Treatment (I)	Treatment (J)	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1.00	2.00	-5.80000(*)	1.31318	.001	-8.6612	-2.9388
	3.00	-4.40000(*)	1.31318	.006	-7.2612	-1.5388
	4.00	-1.40000	1.31318	.307	-4.2612	1.4612
	5.00	-2.80000	1.31318	.054	-5.6612	.0612
	6.00	-9.10000(*)	1.31318	.000	-11.9612	-6.2388
2.00	1.00	5.80000(*)	1.31318	.001	2.9388	8.6612
	3.00	1.40000	1.31318	.307	-1.4612	4.2612
	4.00	4.40000(*)	1.31318	.006	1.5388	7.2612
	5.00	3.00000(*)	1.31318	.041	.1388	5.8612
	6.00	-3.30000(*)	1.31318	.027	-6.1612	-.4388
3.00	1.00	4.40000(*)	1.31318	.006	1.5388	7.2612
	2.00	-1.40000	1.31318	.307	-4.2612	1.4612
	4.00	3.00000(*)	1.31318	.041	.1388	5.8612
	5.00	1.60000	1.31318	.246	-1.2612	4.4612
	6.00	-4.70000(*)	1.31318	.004	-7.5612	-1.8388
4.00	1.00	1.40000	1.31318	.307	-1.4612	4.2612
	2.00	-4.40000(*)	1.31318	.006	-7.2612	-1.5388
	3.00	-3.00000(*)	1.31318	.041	-5.8612	-.1388
	5.00	-1.40000	1.31318	.307	-4.2612	1.4612
	6.00	-7.70000(*)	1.31318	.000	-10.5612	-4.8388
5.00	1.00	2.80000	1.31318	.054	-.0612	5.6612
	2.00	-3.00000(*)	1.31318	.041	-5.8612	-.1388
	3.00	-1.60000	1.31318	.246	-4.4612	1.2612
	4.00	1.40000	1.31318	.307	-1.4612	4.2612
	6.00	-6.30000(*)	1.31318	.000	-9.1612	-3.4388
6.00	1.00	9.10000(*)	1.31318	.000	6.2388	11.9612
	2.00	3.30000(*)	1.31318	.027	.4388	6.1612
	3.00	4.70000(*)	1.31318	.004	1.8388	7.5612
	4.00	7.70000(*)	1.31318	.000	4.8388	10.5612

	5.00	6.30000(*)	1.31318	.000	3.4388	9.1612

* The mean difference is significant at the .05 level

APPENDIX XII

Analysis of Variance(ANOVA)for no.of panicles/pot. (Rice-NR10414)

Source of variation	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	1.111	5	.222	.800	.571
Within Groups	3.333	12	.278		
Total	4.444	17			

LSD Multiple comparision of means on dependant variable Panicles/pot

Treatment (I)	Treatment (J)	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
1.00	2.00	-.66667	.43033	.147	-1.6043	.2709
	3.00	-.66667	.43033	.147	-1.6043	.2709
	4.00	-.33333	.43033	.454	-1.2709	.6043
	5.00	-.33333	.43033	.454	-1.2709	.6043
	6.00	-.66667	.43033	.147	-1.6043	.2709
2.00	1.00	.66667	.43033	.147	-.2709	1.6043
3.00	.00000	.43033	1.000	-.9376	.9376	
4.00	.33333	.43033	.454	-.6043	1.2709	
5.00	.33333	.43033	.454	-.6043	1.2709	
6.00	.00000	.43033	1.000	-.9376	.9376	
3.00	1.00	.66667	.43033	.147	-.2709	1.6043
2.00	.00000	.43033	1.000	-.9376	.9376	
4.00	.33333	.43033	.454	-.6043	1.2709	
5.00	.33333	.43033	.454	-.6043	1.2709	
6.00	.00000	.43033	1.000	-.9376	.9376	
4.00	1.00	.33333	.43033	.454	-.6043	1.2709
2.00	-.33333	.43033	.454	-1.2709	.6043	

3.00	-.33333	.43033	.454	-1.2709	.6043	
5.00	.00000	.43033	1.000	-.9376	.9376	
6.00	-.33333	.43033	.454	-1.2709	.6043	
5.00	1.00	.33333	.43033	.454	-.6043	1.2709
2.00	-.33333	.43033	.454	-1.2709	.6043	
3.00	-.33333	.43033	.454	-1.2709	.6043	
4.00	.00000	.43033	1.000	-.9376	.9376	
6.00	-.33333	.43033	.454	-1.2709	.6043	
6.00	1.00	.66667	.43033	.147	-.2709	1.6043
2.00	.00000	.43033	1.000	-.9376	.9376	
3.00	.00000	.43033	1.000	-.9376	.9376	
4.00	.33333	.43033	.454	-.6043	1.2709	
5.00	.33333	.43033	.454	-.6043	1.2709	

* The mean difference is significant at the .05 level

APPENDIX XIII

Analysis of Variance(ANOVA)for no.of spikes per panicles in the pot. (Rice-NR10414)

Source of variation	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	9.884	5	1.977	24.711	.000
Within Groups	.960	12	.080		
Total	10.844	17			

LSD Multiple comparision of means on dependant variable Spikes/panicle

Treatment (I)	Treatment (J)	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1.00	2.00	-1.40000(*)	.23094	.000	-1.9032	-.8968
	3.00	-1.06667(*)	.23094	.001	-1.5698	-.5635
	4.00	.33333	.23094	.175	-.1698	.8365
	5.00	-.13333	.23094	.574	-.6365	.3698
	6.00	-1.60000(*)	.23094	.000	-2.1032	-1.0968
2.00	1.00	1.40000(*)	.23094	.000	.8968	1.9032
	3.00	.33333	.23094	.175	-.1698	.8365
	4.00	1.73333(*)	.23094	.000	1.2302	2.2365
	5.00	1.26667(*)	.23094	.000	.7635	1.7698
	6.00	-.20000	.23094	.403	-.7032	.3032
3.00	1.00	1.06667(*)	.23094	.001	.5635	1.5698
	2.00	-.33333	.23094	.175	-.8365	.1698
	4.00	1.40000(*)	.23094	.000	.8968	1.9032
	5.00	.93333(*)	.23094	.002	.4302	1.4365
	6.00	-.53333(*)	.23094	.040	-1.0365	-.0302
4.00	1.00	-.33333	.23094	.175	-.8365	.1698
	2.00	-1.73333(*)	.23094	.000	-2.2365	-1.2302
	3.00	-1.40000(*)	.23094	.000	-1.9032	-.8968
	5.00	-.46667	.23094	.066	-.9698	.0365
	6.00	-1.93333(*)	.23094	.000	-2.4365	-1.4302
5.00	1.00	.13333	.23094	.574	-.3698	.6365
	2.00	-1.26667(*)	.23094	.000	-1.7698	-.7635
	3.00	-.93333(*)	.23094	.002	-1.4365	-.4302
	4.00	.46667	.23094	.066	-.0365	.9698
	6.00	-1.46667(*)	.23094	.000	-1.9698	-.9635
6.00	1.00	1.60000(*)	.23094	.000	1.0968	2.1032
	2.00	.20000	.23094	.403	-.3032	.7032
	3.00	.53333(*)	.23094	.040	.0302	1.0365

	4.00	1.93333(*)	.23094	.000	1.4302	2.4365
	5.00	1.46667(*)	.23094	.000	.9635	1.9698

* The mean difference is significant at the .05 level

APPENDIX IV

Analysis of Variance(ANOVA)for no.of grains per panicle in the pot. (Rice-NR10414)

Source of variation	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	56.069	5	11.214	12.816	.000
Within Groups	10.500	12	.875		
Total	66.569	17			

LSD Multiple comparision of means on dependant variable No.of grains/panicle

Treatment (I)	Treatment (J)	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1.00	2.00	-3.83333(*)	.76376	.000	-5.4974	-2.1692
	3.00	-3.66667(*)	.76376	.000	-5.3308	-2.0026
	4.00	-.66667	.76376	.400	-2.3308	.9974
	5.00	-1.33333	.76376	.106	-2.9974	.3308
	6.00	-4.66667(*)	.76376	.000	-6.3308	-3.0026
2.00	1.00	3.83333(*)	.76376	.000	2.1692	5.4974
	3.00	.16667	.76376	.831	-1.4974	1.8308
	4.00	3.16667(*)	.76376	.001	1.5026	4.8308
	5.00	2.50000(*)	.76376	.007	.8359	4.1641
	6.00	-.83333	.76376	.297	-2.4974	.8308
3.00	1.00	3.66667(*)	.76376	.000	2.0026	5.3308
	2.00	-.16667	.76376	.831	-1.8308	1.4974
	4.00	3.00000(*)	.76376	.002	1.3359	4.6641
	5.00	2.33333(*)	.76376	.010	.6692	3.9974
	6.00	-1.00000	.76376	.215	-2.6641	.6641
4.00	1.00	.66667	.76376	.400	-.9974	2.3308
	2.00	-3.16667(*)	.76376	.001	-4.8308	-1.5026
	3.00	-3.00000(*)	.76376	.002	-4.6641	-1.3359
	5.00	-.66667	.76376	.400	-2.3308	.9974
	6.00	-4.00000(*)	.76376	.000	-5.6641	-2.3359
5.00	1.00	1.33333	.76376	.106	-.3308	2.9974
	2.00	-2.50000(*)	.76376	.007	-4.1641	-.8359
	3.00	-2.33333(*)	.76376	.010	-3.9974	-.6692
	4.00	.66667	.76376	.400	-.9974	2.3308
	6.00	-3.33333(*)	.76376	.001	-4.9974	-1.6692
6.00	1.00	4.66667(*)	.76376	.000	3.0026	6.3308
	2.00	.83333	.76376	.297	-.8308	2.4974
	3.00	1.00000	.76376	.215	-.6641	2.6641

	4.00	4.00000(*)	.76376	.000	2.3359	5.6641
	5.00	3.33333(*)	.76376	.001	1.6692	4.9974

* The mean difference is significant at the .05 level

APPENDIX XV

Analysis of Variance(ANOVA)for wt.of 1000 grains(gm) in the pot. (Rice-NR10414)

Source of variation	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	2.703	5	.541	3.988	.023
Within Groups	1.627	12	.136		
Total	4.329	17			

LSD Multiple comparision of means on dependant variable Wt.of 1000 grains(gm).

Treatment (I)	Treatment (J)	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1.00	2.00	-.83333(*)	.30062	.017	-1.4883	-.1783
	3.00	-.60000	.30062	.069	-1.2550	.0550
	4.00	-.10000	.30062	.745	-.7550	.5550
	5.00	-.40000	.30062	.208	-1.0550	.2550
	6.00	-1.10000(*)	.30062	.003	-1.7550	-.4450
2.00	1.00	.83333(*)	.30062	.017	.1783	1.4883
	3.00	.23333	.30062	.453	-.4217	.8883
	4.00	.73333(*)	.30062	.031	.0783	1.3883
	5.00	.43333	.30062	.175	-.2217	1.0883
	6.00	-.26667	.30062	.392	-.9217	.3883
3.00	1.00	.60000	.30062	.069	-.0550	1.2550
	2.00	-.23333	.30062	.453	-.8883	.4217
	4.00	.50000	.30062	.122	-.1550	1.1550
	5.00	.20000	.30062	.518	-.4550	.8550
	6.00	-.50000	.30062	.122	-1.1550	.1550
4.00	1.00	.10000	.30062	.745	-.5550	.7550
	2.00	-.73333(*)	.30062	.031	-1.3883	-.0783
	3.00	-.50000	.30062	.122	-1.1550	.1550
	5.00	-.30000	.30062	.338	-.9550	.3550
	6.00	-1.00000(*)	.30062	.006	-1.6550	-.3450
5.00	1.00	.40000	.30062	.208	-.2550	1.0550
	2.00	-.43333	.30062	.175	-1.0883	.2217
	3.00	-.20000	.30062	.518	-.8550	.4550
	4.00	.30000	.30062	.338	-.3550	.9550
	6.00	-.70000(*)	.30062	.038	-1.3550	-.0450
6.00	1.00	1.10000(*)	.30062	.003	.4450	1.7550
	2.00	.26667	.30062	.392	-.3883	.9217
	3.00	.50000	.30062	.122	-.1550	1.1550
	4.00	1.00000(*)	.30062	.006	.3450	1.6550

	5.00	.70000(*)	.30062	.038	.0450	1.3550

* The mean difference is significant at the .05 level

APPENDIX XVI

Analysis of Variance(ANOVA)for grain yield(gm/pot) in the pot. (Rice-NR10414)

Source of variation	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	15.378	5	3.076	3.202	.046
Within Groups	11.527	12	.961		
Total	26.905	17			

LSD Multiple comparision of means on dependant variable Grain yield(gm/pot).

Treatment (I)	Treatment (J)	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1.00	2.00	-2.26667(*)	.80023	.015	-4.0102	-.5231
	3.00	-2.10000(*)	.80023	.022	-3.8436	-.3564
	4.00	-.73333	.80023	.378	-2.4769	1.0102
	5.00	-1.03333	.80023	.221	-2.7769	.7102
	6.00	-2.56667(*)	.80023	.008	-4.3102	-.8231
2.00	1.00	2.26667(*)	.80023	.015	.5231	4.0102
	3.00	.16667	.80023	.839	-1.5769	1.9102
	4.00	1.53333	.80023	.079	-.2102	3.2769
	5.00	1.23333	.80023	.149	-.5102	2.9769
	6.00	-.30000	.80023	.714	-2.0436	1.4436
3.00	1.00	2.10000(*)	.80023	.022	.3564	3.8436
	2.00	-.16667	.80023	.839	-1.9102	1.5769
	4.00	1.36667	.80023	.113	-.3769	3.1102
	5.00	1.06667	.80023	.207	-.6769	2.8102
	6.00	-.46667	.80023	.571	-2.2102	1.2769
4.00	1.00	.73333	.80023	.378	-1.0102	2.4769
	2.00	-1.53333	.80023	.079	-3.2769	.2102
	3.00	-1.36667	.80023	.113	-3.1102	.3769
	5.00	-.30000	.80023	.714	-2.0436	1.4436
	6.00	-1.83333(*)	.80023	.041	-3.5769	-.0898
5.00	1.00	1.03333	.80023	.221	-.7102	2.7769
	2.00	-1.23333	.80023	.149	-2.9769	.5102
	3.00	-1.06667	.80023	.207	-2.8102	.6769
	4.00	.30000	.80023	.714	-1.4436	2.0436
	6.00	-1.53333	.80023	.079	-3.2769	.2102
6.00	1.00	2.56667(*)	.80023	.008	.8231	4.3102
	2.00	.30000	.80023	.714	-1.4436	2.0436

	3.00	.46667	.80023	.571	-1.2769	2.2102
	4.00	1.83333(*)	.80023	.041	.0898	3.5769
	5.00	1.53333	.80023	.079	-.2102	3.2769

* The mean difference is significant at the .05 level

APPENDIX XVII

14. Analysis of Variance(ANOVA)for straw yield(gm/pot) in the pot. (Rice-NR10414)

Source of variation	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	142.785	5	28.557	46.560	.000
Within Groups	7.360	12	.613		
Total	150.145	17			

LSD Multiple comparision of means on dependant variable Straw yield(gm/pot).

Treatment (I)	Treatment (J)	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1.00	2.00	-7.30000(*)	.63944	.000	-8.6932	-5.9068
	3.00	-4.80000(*)	.63944	.000	-6.1932	-3.4068
	4.00	-3.40000(*)	.63944	.000	-4.7932	-2.0068
	5.00	-4.20000(*)	.63944	.000	-5.5932	-2.8068
	6.00	-8.80000(*)	.63944	.000	-10.1932	-7.4068
2.00	1.00	7.30000(*)	.63944	.000	5.9068	8.6932
	3.00	2.50000(*)	.63944	.002	1.1068	3.8932
	4.00	3.90000(*)	.63944	.000	2.5068	5.2932
	5.00	3.10000(*)	.63944	.000	1.7068	4.4932
	6.00	-1.50000(*)	.63944	.037	-2.8932	-.1068
3.00	1.00	4.80000(*)	.63944	.000	3.4068	6.1932
	2.00	-2.50000(*)	.63944	.002	-3.8932	-1.1068
	4.00	1.40000(*)	.63944	.049	.0068	2.7932
	5.00	.60000	.63944	.367	-.7932	1.9932
	6.00	-4.00000(*)	.63944	.000	-5.3932	-2.6068
4.00	1.00	3.40000(*)	.63944	.000	2.0068	4.7932
	2.00	-3.90000(*)	.63944	.000	-5.2932	-2.5068
	3.00	-1.40000(*)	.63944	.049	-2.7932	-.0068
	5.00	-.80000	.63944	.235	-2.1932	.5932
	6.00	-5.40000(*)	.63944	.000	-6.7932	-4.0068
5.00	1.00	4.20000(*)	.63944	.000	2.8068	5.5932
	2.00	-3.10000(*)	.63944	.000	-4.4932	-1.7068
	3.00	-.60000	.63944	.367	-1.9932	.7932
	4.00	.80000	.63944	.235	-.5932	2.1932
	6.00	-4.60000(*)	.63944	.000	-5.9932	-3.2068
6.00	1.00	8.80000(*)	.63944	.000	7.4068	10.1932
	2.00	1.50000(*)	.63944	.037	.1068	2.8932

	3.00	4.00000(*)	.63944	.000	2.6068	5.3932
	4.00	5.40000(*)	.63944	.000	4.0068	6.7932
	5.00	4.60000(*)	.63944	.000	3.2068	5.9932

* The mean difference is significant at the .05 level

APPENDIX XVIII

Analysis of Variance(ANOVA) for plant height(cm) in the pot(Rice-Mansuli).

Source of variation	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	178.680	5	35.736	30.587	.000
Within Groups	14.020	12	1.168		
Total	192.700	17			

LSD Multiple comparision of means on dependant variable Plant height in pot

Treatment (I)	Treatment (J)	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1.00	2.00	-7.50000(*)	.88255	.000	-9.4229	-5.5771
	3.00	-6.70000(*)	.88255	.000	-8.6229	-4.7771
	4.00	-1.70000	.88255	.078	-3.6229	.2229
	5.00	-3.20000(*)	.88255	.003	-5.1229	-1.2771
	6.00	-8.50000(*)	.88255	.000	-10.4229	-6.5771
2.00	1.00	7.50000(*)	.88255	.000	5.5771	9.4229
	3.00	.80000	.88255	.383	-1.1229	2.7229
	4.00	5.80000(*)	.88255	.000	3.8771	7.7229
	5.00	4.30000(*)	.88255	.000	2.3771	6.2229
	6.00	-1.00000	.88255	.279	-2.9229	.9229
3.00	1.00	6.70000(*)	.88255	.000	4.7771	8.6229
	2.00	-.80000	.88255	.383	-2.7229	1.1229
	4.00	5.00000(*)	.88255	.000	3.0771	6.9229
	5.00	3.50000(*)	.88255	.002	1.5771	5.4229
	6.00	-1.80000	.88255	.064	-3.7229	.1229
4.00	1.00	1.70000	.88255	.078	-.2229	3.6229
	2.00	-5.80000(*)	.88255	.000	-7.7229	-3.8771
	3.00	-5.00000(*)	.88255	.000	-6.9229	-3.0771
	5.00	-1.50000	.88255	.115	-3.4229	.4229
	6.00	-6.80000(*)	.88255	.000	-8.7229	-4.8771
5.00	1.00	3.20000(*)	.88255	.003	1.2771	5.1229
	2.00	-4.30000(*)	.88255	.000	-6.2229	-2.3771
	3.00	-3.50000(*)	.88255	.002	-5.4229	-1.5771
	4.00	1.50000	.88255	.115	-.4229	3.4229
	6.00	-5.30000(*)	.88255	.000	-7.2229	-3.3771

	1.00	8.50000(*)	.88255	.000	6.5771	10.4229
	2.00	1.00000	.88255	.279	-.9229	2.9229
	3.00	1.80000	.88255	.064	-.1229	3.7229
	4.00	6.80000(*)	.88255	.000	4.8771	8.7229
	5.00	5.30000(*)	.88255	.000	3.3771	7.2229

* The mean difference is significant at the .05 level

APPENDIX XIX

Analysis of Variance(ANOVA)for no.of panicles per pot. (Rice-Mansuli)

Source of variation	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	1.111	5	.222	.800	.571
Within Groups	3.333	12	.278		
Total	4.444	17			

LSD Multiple comparision of means on dependant variable Panicles/pot

Treatment (I)	Treatment (J)	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
1.00	2.00	-.66667	.43033	.147	-1.6043	.2709
	3.00	-.66667	.43033	.147	-1.6043	.2709
	4.00	-.33333	.43033	.454	-1.2709	.6043
	5.00	-.33333	.43033	.454	-1.2709	.6043
	6.00	-.66667	.43033	.147	-1.6043	.2709
2.00	1.00	.66667	.43033	.147	-.2709	1.6043
3.00	.00000	.43033	1.000	-.9376	.9376	
4.00	.33333	.43033	.454	-.6043	1.2709	
5.00	.33333	.43033	.454	-.6043	1.2709	
6.00	.00000	.43033	1.000	-.9376	.9376	
3.00	1.00	.66667	.43033	.147	-.2709	1.6043
2.00	.00000	.43033	1.000	-.9376	.9376	
4.00	.33333	.43033	.454	-.6043	1.2709	
5.00	.33333	.43033	.454	-.6043	1.2709	
6.00	.00000	.43033	1.000	-.9376	.9376	
4.00	1.00	.33333	.43033	.454	-.6043	1.2709
2.00	-.33333	.43033	.454	-1.2709	.6043	

3.00	-.33333	.43033	.454	-1.2709	.6043	
5.00	.00000	.43033	1.000	-.9376	.9376	
6.00	-.33333	.43033	.454	-1.2709	.6043	
5.00	1.00	.33333	.43033	.454	-.6043	1.2709
2.00	-.33333	.43033	.454	-1.2709	.6043	
3.00	-.33333	.43033	.454	-1.2709	.6043	
4.00	.00000	.43033	1.000	-.9376	.9376	
6.00	-.33333	.43033	.454	-1.2709	.6043	
6.00	1.00	.66667	.43033	.147	-.2709	1.6043
2.00	.00000	.43033	1.000	-.9376	.9376	
3.00	.00000	.43033	1.000	-.9376	.9376	
4.00	.33333	.43033	.454	-.6043	1.2709	
5.00	.33333	.43033	.454	-.6043	1.2709	

* The mean difference is significant at the .05 level

APPENDIX XX

17 Analysis of Variance(ANOVA)for no.of spikes per panicles in the pot. (Rice-Mansuli)

Source of variation	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	3.253	5	.651	3.571	.033
Within Groups	2.187	12	.182		
Total	5.440	17			

LSD Multiple comparision of means on dependant variable Spikes/panicle.

Treatment (I)	Treatment (J)	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1.00	2.00	-1.00000(*)	.34854	.014	-1.7594	-.2406
	3.00	-.76667(*)	.34854	.048	-1.5261	-.0073
	4.00	-.16667	.34854	.641	-.9261	.5927
	5.00	-.33333	.34854	.358	-1.0927	.4261
	6.00	-1.13333(*)	.34854	.007	-1.8927	-.3739
2.00	1.00	1.00000(*)	.34854	.014	.2406	1.7594
	3.00	.23333	.34854	.516	-.5261	.9927
	4.00	.83333(*)	.34854	.034	.0739	1.5927
	5.00	.66667	.34854	.080	-.0927	1.4261
	6.00	-.13333	.34854	.709	-.8927	.6261
3.00	1.00	.76667(*)	.34854	.048	.0073	1.5261
	2.00	-.23333	.34854	.516	-.9927	.5261
	4.00	.60000	.34854	.111	-.1594	1.3594
	5.00	.43333	.34854	.238	-.3261	1.1927
	6.00	-.36667	.34854	.314	-1.1261	.3927
4.00	1.00	.16667	.34854	.641	-.5927	.9261
	2.00	-.83333(*)	.34854	.034	-1.5927	-.0739
	3.00	-.60000	.34854	.111	-1.3594	.1594
	5.00	-.16667	.34854	.641	-.9261	.5927
	6.00	-.96667(*)	.34854	.017	-1.7261	-.2073
5.00	1.00	.33333	.34854	.358	-.4261	1.0927
	2.00	-.66667	.34854	.080	-1.4261	.0927
	3.00	-.43333	.34854	.238	-1.1927	.3261
	4.00	.16667	.34854	.641	-.5927	.9261
	6.00	-.80000(*)	.34854	.041	-1.5594	-.0406
6.00	1.00	1.13333(*)	.34854	.007	.3739	1.8927
	2.00	.13333	.34854	.709	-.6261	.8927
	3.00	.36667	.34854	.314	-.3927	1.1261

	4.00	.96667(*)	.34854	.017	.2073	1.7261
	5.00	.80000(*)	.34854	.041	.0406	1.5594

* The mean difference is significant at the .05 level

APPENDIX XXI

Analysis of Variance(ANOVA)for no.of grains per panicle in the pot. (Rice-Mansuli)

Source of variation	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	8.080	5	1.616	5.841	.006
Within Groups	3.320	12	.277		
Total	11.400	17			

LSD Multiple comparision of means on dependant variable Grains/panicle.

Treatment (I)	Treatment (J)	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1.00	2.00	-.93333	.42947	.051	-1.8691	.0024
	3.00	-.43333	.42947	.333	-1.3691	.5024
	4.00	-.33333	.42947	.453	-1.2691	.6024
	5.00	-.80000	.42947	.087	-1.7357	.1357
	6.00	-2.10000(*)	.42947	.000	-3.0357	-1.1643
2.00	1.00	.93333	.42947	.051	-.0024	1.8691
	3.00	.50000	.42947	.267	-.4357	1.4357
	4.00	.60000	.42947	.188	-.3357	1.5357
	5.00	.13333	.42947	.762	-.8024	1.0691
	6.00	-1.16667(*)	.42947	.019	-2.1024	-.2309
3.00	1.00	.43333	.42947	.333	-.5024	1.3691
	2.00	-.50000	.42947	.267	-1.4357	.4357
	4.00	.10000	.42947	.820	-.8357	1.0357
	5.00	-.36667	.42947	.410	-1.3024	.5691
	6.00	-1.66667(*)	.42947	.002	-2.6024	-.7309
4.00	1.00	.33333	.42947	.453	-.6024	1.2691
	2.00	-.60000	.42947	.188	-1.5357	.3357
	3.00	-.10000	.42947	.820	-1.0357	.8357
	5.00	-.46667	.42947	.299	-1.4024	.4691
	6.00	-1.76667(*)	.42947	.001	-2.7024	-.8309
5.00	1.00	.80000	.42947	.087	-.1357	1.7357
	2.00	-.13333	.42947	.762	-1.0691	.8024
	3.00	.36667	.42947	.410	-.5691	1.3024
	4.00	.46667	.42947	.299	-.4691	1.4024
	6.00	-1.30000(*)	.42947	.011	-2.2357	-.3643
6.00	1.00	2.10000(*)	.42947	.000	1.1643	3.0357
	2.00	1.16667(*)	.42947	.019	.2309	2.1024
	3.00	1.66667(*)	.42947	.002	.7309	2.6024
	4.00	1.76667(*)	.42947	.001	.8309	2.7024

	5.00	1.30000(*)	.42947	.011	.3643	2.2357

* The mean difference is significant at the .05 level

APPENDIX XXII

Analysis of Variance(ANOVA)for wt.of 1000 grains(gm) in the pot. (Rice-Mansuli)

Source of variation	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	2.185	5	.437	3.405	.038
Within Groups	1.540	12	.128		
Total	3.725	17			

LSD Multiple comparision of means on dependant variable Wt. of 1000 grains(gm)

Treatment (I)	Treatment (J)	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1.00	2.00	-.80000(*)	.29250	.018	-1.4373	-.1627
	3.00	-.70000(*)	.29250	.034	-1.3373	-.0627
	4.00	-.20000	.29250	.507	-.8373	.4373
	5.00	-.40000	.29250	.197	-1.0373	.2373
	6.00	-1.00000(*)	.29250	.005	-1.6373	-.3627
2.00	1.00	.80000(*)	.29250	.018	.1627	1.4373
	3.00	.10000	.29250	.738	-.5373	.7373
	4.00	.60000	.29250	.063	-.0373	1.2373
	5.00	.40000	.29250	.197	-.2373	1.0373
	6.00	-.20000	.29250	.507	-.8373	.4373
3.00	1.00	.70000(*)	.29250	.034	.0627	1.3373
	2.00	-.10000	.29250	.738	-.7373	.5373
	4.00	.50000	.29250	.113	-.1373	1.1373
	5.00	.30000	.29250	.325	-.3373	.9373
	6.00	-.30000	.29250	.325	-.9373	.3373
4.00	1.00	.20000	.29250	.507	-.4373	.8373
	2.00	-.60000	.29250	.063	-1.2373	.0373
	3.00	-.50000	.29250	.113	-1.1373	.1373
	5.00	-.20000	.29250	.507	-.8373	.4373
	6.00	-.80000(*)	.29250	.018	-1.4373	-.1627
5.00	1.00	.40000	.29250	.197	-.2373	1.0373
	2.00	-.40000	.29250	.197	-1.0373	.2373
	3.00	-.30000	.29250	.325	-.9373	.3373
	4.00	.20000	.29250	.507	-.4373	.8373
	6.00	-.60000	.29250	.063	-1.2373	.0373
	1.00	1.00000(*)	.29250	.005	.3627	1.6373
	2.00	.20000	.29250	.507	-.4373	.8373
	3.00	.30000	.29250	.325	-.3373	.9373
	4.00	.80000(*)	.29250	.018	.1627	1.4373

	5.00	.60000	.29250	.063	-.0373	1.2373

* The mean difference is significant at the .05 level

APPENDIX XXIII

Analysis of Variance(ANOVA)for grain yield(gm/pot) in the pot. (Rice -Mansuli)

Source of variation	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	5.651	5	1.130	2.454	.094
Within Groups	5.527	12	.461		
Total	11.178	17			

LSD Multiple comparision of means on dependant variable Grain yield(gm/pot)

Treatment (I)	Treatment (J)	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1.00	2.00	-1.33333(*)	.55411	.033	-2.5406	-.1260
	3.00	-1.30000(*)	.55411	.037	-2.5073	-.0927
	4.00	-.53333	.55411	.355	-1.7406	.6740
	5.00	-.66667	.55411	.252	-1.8740	.5406
	6.00	-1.63333(*)	.55411	.012	-2.8406	-.4260
2.00	1.00	1.33333(*)	.55411	.033	.1260	2.5406
	3.00	.03333	.55411	.953	-1.1740	1.2406
	4.00	.80000	.55411	.174	-.4073	2.0073
	5.00	.66667	.55411	.252	-.5406	1.8740
	6.00	-.30000	.55411	.598	-1.5073	.9073
3.00	1.00	1.30000(*)	.55411	.037	.0927	2.5073
	2.00	-.03333	.55411	.953	-1.2406	1.1740
	4.00	.76667	.55411	.192	-.4406	1.9740
	5.00	.63333	.55411	.275	-.5740	1.8406
	6.00	-.33333	.55411	.559	-1.5406	.8740
4.00	1.00	.53333	.55411	.355	-.6740	1.7406
	2.00	-.80000	.55411	.174	-2.0073	.4073
	3.00	-.76667	.55411	.192	-1.9740	.4406
	5.00	-.13333	.55411	.814	-1.3406	1.0740
	6.00	-1.10000	.55411	.070	-2.3073	.1073
5.00	1.00	.66667	.55411	.252	-.5406	1.8740
	2.00	-.66667	.55411	.252	-1.8740	.5406
	3.00	-.63333	.55411	.275	-1.8406	.5740
	4.00	.13333	.55411	.814	-1.0740	1.3406
	6.00	-.96667	.55411	.107	-2.1740	.2406
	1.00	1.63333(*)	.55411	.012	.4260	2.8406
	2.00	.30000	.55411	.598	-.9073	1.5073
	3.00	.33333	.55411	.559	-.8740	1.5406
	4.00	1.10000	.55411	.070	-.1073	2.3073

	5.00	.96667	.55411	.107	-.2406	2.1740

* The mean difference is significant at the .05 level

APPENDIX XXIV

Analysis of Variance(ANOVA)for straw yield(gm/pot) in the pot.

(Rice -Mansuli)

Source of variation	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	163.765	5	32.753	90.561	.000
Within Groups	4.340	12	.362		
Total	168.105	17			

LSD Multiple comparision of means on dependant variable Straw yield(gm/pot)

Treatment (I)	Treatment (J)	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1.00	2.00	-7.60000(*)	.49103	.000	-8.6699	-6.5301
	3.00	-6.70000(*)	.49103	.000	-7.7699	-5.6301
	4.00	-2.90000(*)	.49103	.000	-3.9699	-1.8301
	5.00	-4.40000(*)	.49103	.000	-5.4699	-3.3301
	6.00	-8.90000(*)	.49103	.000	-9.9699	-7.8301
2.00	1.00	7.60000(*)	.49103	.000	6.5301	8.6699
	3.00	.90000	.49103	.092	-.1699	1.9699
	4.00	4.70000(*)	.49103	.000	3.6301	5.7699
	5.00	3.20000(*)	.49103	.000	2.1301	4.2699
	6.00	-1.30000(*)	.49103	.021	-2.3699	-.2301
3.00	1.00	6.70000(*)	.49103	.000	5.6301	7.7699
	2.00	-.90000	.49103	.092	-1.9699	.1699
	4.00	3.80000(*)	.49103	.000	2.7301	4.8699
	5.00	2.30000(*)	.49103	.001	1.2301	3.3699
	6.00	-2.20000(*)	.49103	.001	-3.2699	-1.1301
4.00	1.00	2.90000(*)	.49103	.000	1.8301	3.9699
	2.00	-4.70000(*)	.49103	.000	-5.7699	-3.6301
	3.00	-3.80000(*)	.49103	.000	-4.8699	-2.7301
	5.00	-1.50000(*)	.49103	.010	-2.5699	-.4301
	6.00	-6.00000(*)	.49103	.000	-7.0699	-4.9301
5.00	1.00	4.40000(*)	.49103	.000	3.3301	5.4699
	2.00	-3.20000(*)	.49103	.000	-4.2699	-2.1301
	3.00	-2.30000(*)	.49103	.001	-3.3699	-1.2301
	4.00	1.50000(*)	.49103	.010	.4301	2.5699
	6.00	-4.50000(*)	.49103	.000	-5.5699	-3.4301
	1.00	8.90000(*)	.49103	.000	7.8301	9.9699
	2.00	1.30000(*)	.49103	.021	.2301	2.3699
	3.00	2.20000(*)	.49103	.001	1.1301	3.2699

	4.00	6.00000(*)	.49103	.000	4.9301	7.0699
	5.00	4.50000(*)	.49103	.000	3.4301	5.5699

* The mean difference is significant at the .05 leve

PHOTO PLATE :1

Photo 1 : Preparation of field for rice transplantation

Photo 2 : Paddy field

Photo 3 : BGA growing in paddy field

Photo 4 : BGA growing in pot in green house

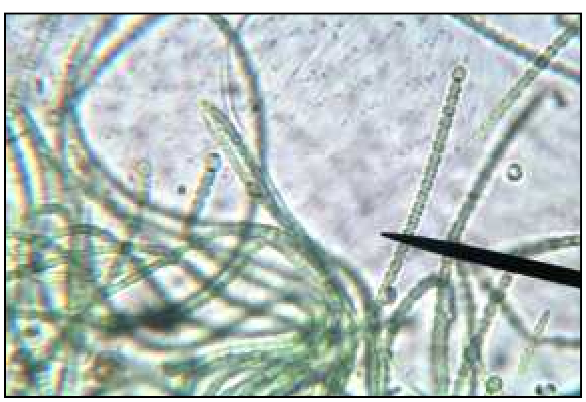

Photo 5 : *Anabaena sp.*

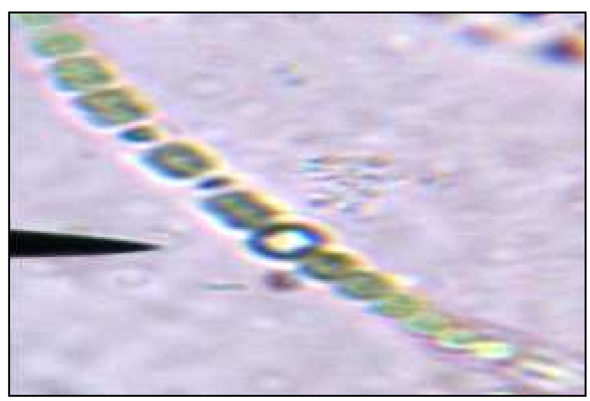

Photo 6 : *Nostoc muscorum*