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Growth Parameter and Yield Attributes of Rice (*Oryza Sativa*) as Influenced by Different Combination of Nitrogen Sources

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Abstract The study was carried out in agronomy farm of Paklihawa Campus, IAAS, Rupandehi, Nepal. The objective of the study was to determine the response of rice as influenced by different combination of organic and inorganic nitrogen sources. The study consists of three nitrogen sources i.e. urea, farmyard manure and blue green algae at various levels comprising seven treatments in randomized complete block design with three replications. Rice seedling were raised in wet nursery bed and transplanted in experimental plots. Growth parameters, yield attributing traits and grain yield of rice were recorded. Result indicates that treatment combination of 75% of recommended dose of nitrogen (90 kg ha^{-1}), farmyard manure (5 tons ha^{-1}) and blue green algae (9 kg ha^{-1}) contributes to higher plant height (96.13 cm), effective tiller per square meter (345.6), filled grain per panicle (180.9), grain yield (4.787 tons ha^{-1}), and straw yield (9.07 ton ha^{-1}) ($p < 0.05$). Also, there was a positive correlation between the grain yield and effective tillers per square meter (R^2=0.254), grain yield and number of filled grains per panicle (R^2=0.315). Hence, 75% of recommended dose of nitrogen (90 kg ha^{-1}), farmyard manure (5 tons ha^{-1}) and blue green algae (9 kg ha^{-1}) were found to improve plant characteristics thus improving rice yield.

Keywords: *blue green algae, Farmyard manure, Urea*

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1. Introduction

Rice (*Oryza sativa*) is a primary source of food for more than half of the world's population [8]. It is a staple crop for approximately 3.5 billion people around the world [8]. Rice supplies 50% of the dietary calories as well as is a substantial part of the protein intake for about 520 million people living in poverty in Asia [12]. In Nepal, rice is one of the most important cereal crops, cultivated in 1.42 million hectares of land producing 4.5 million tons of rice with average productivity of 3.17 $tonha^{-1}$ [11]. However, due to decreasing agricultural land coupled with increasing population, improper use of fertilizers and climate change, production is still below the demand. Lack of high yielding cultivars, lodging, weed infestation, water-logging condition, low moisture, and low fertility are some of the factors contributing to low yield of rice [23]. However, very limited study is available to what extent the crop management components affect rice yield.

Various efforts have been made to increase production to feed the growing population. Farmers have become mindful about crop management practices and with the introduction of commercial fertilizers and rice varieties, rice production is also increasing. Fertilizer application plays a crucial role in growth and yield of rice, mainly nitrogenous fertilizer, that is essential for the initiation of leaves and florets primordia during early growth period [24]. Type of nitrogenous fertilizer may also affect the grain quality and yield. Some of these fertilizers, like urea, are substantially cheaper than others, provided they do not adversely affect the yield or quality of the grain [4].

Mostly farmers apply costly nitrogenous fertilizer in excessive amount to get a higher yield [17], but imbalance use of N fertilizer causes harm to the crop and decrease grain yield. Bio-fertilizers are eco-friendly, cost effective and fuel independent, used as alternative source of nitrogen to the chemical fertilizers. Blue Green Algae (BGA) are used as bio-fertilizers that fix atmospheric nitrogen in specialized cells called heterocyst under anaerobic conditions [3]. BGA maintain and build-up soil fertility thus, increasing rice growth and yield [21]. Integrated management of inorganic and organic fertilizers can be essential for rice production. Integrated use of organic manures (including BGA) and inorganic fertilizer (prilled urea) increased yield of low land rice as compared to sole use of urea [13]. Rice yield and growth characters were found to be increased significantly in treatment where bio fertilizers (BGA) and mineral nitrogen fertilizer were used combinely [15].

Rice crops utilize 16-17 kg N to produce each ton of rough rice including straw [16]. Nitrogen is the yield limiting nutrient for rice production [2]. Inappropriate application of nitrogen fertilizer causes environmental pollution [6] beside contributing to crop failure and increase production cost. It is therefore, worthy to study inorganic and organic nitrogen response on rice growth and development.

There are many challenges associated to rice production in Nepal. However, use of improper combination of chemical and organic fertilizers, and poor soil fertility management practices are the key constraint for rice production in Nepal. There is an immense potential to increase crop yield through judicious use of inputs and adoption of improved technologies [10]. The objective of the study was to determine the yield and yield attributing characteristics of rice as influenced by different combination of nitrogen sources.

2. Materials and Methods

2.1. Study Site

The study was carried out at Agronomy farm of Paklihawa Campus, Rupandehi, Nepal (27° 28' N; 83° 27' E; 104 masl). The study site is located about 3 km South-West from Bhairahawa, Headquarter of Rupandehi District, Nepal. The study site is a low land in plain area dominated with alluvial clay soil with 1.88% organic matter and a pH of 7.4 (Sapkota et al., 2015). The reported N, P_2O_5, and K_2O for the soil was 0.09%, 49.9 kg ha^{-1}, and 130.4 kg ha^{-1} respectively [18].

2.2. Experimental Set up

2.2.1. Field Layout

The study comprised of 7 treatments (Table 1) with 3 replications for each treatment in Randomized Complete Block Design (RCBD) model. Each replication was separated by 1m alley, while each plot was separated by 0.5m bund space. The individual plot size was 9 m^2 with 3m length and 3m breadth. The crop geometry was 0.2m x 0.2m, row to row and plant to plant distance maintaining 15 rows with 15 hills per row in each plot. The central eleven rows were considered as net plot rows for yield calculation and taking biometrical observations. Two rows on each side of net plot rows were used to take destructive samples for growth analysis. The remaining two rows on each side of destructive rows were considered as border row.

Table 1. Treatments with different combination of fertilizers randomly allocated at different study plots, Rupandehi, Nepal, 2015

Treatments	Combination of fertilizer
T1	50%RDN[†] (60 kg ha^{-1}) +FYM +BGA
T2	75%RDN ((90 kg ha^{-1}) +FYM
T3	75%RDN (90 kg ha^{-1}) + BGA
T4	75%RDN (90kg ha^{-1}) +FYM +BGA
T5	100% RDN (120kg ha$^{-1)}$ + FYM
T6	100% RDN (120kg ha^{-1}) + BGA
T7	100% RDN (120kg ha^{-1}) + FYM +BGA

[†] RDN= Recommended dose of nitrogen; FYM= Farmyard manure; BGA= Blue green algae.

2.2.2. Treatment Detail

Treatmeants: 7
Replication: 3
Plot size: 3 m×3 m
Spacing: 0.2m × 0.2m between hill to hill.
The net area the cultivation: 189 m^2
The gross area: 338 m^2
Rice variety: Sampurna.

2.3. Cultivation Practices Adapted

Nursery beds were prepared at small plot. Seedlings were raised in wet nursery bed. Well decomposed farm yard manure (FYM) was thoroughly mixed with pulverized soil while no chemical fertilizer was used. Nursery beds were prepared maintaining 3 m length and 1.5 m width. Seeds were sown at 50 kg ha^{-1} for given cultivar of rice. Seeds were soaked for 24 hours and were evenly sown in line in well leveled nursery bed. Light irrigation through pipe was given three hours before uprooting for easier uprooting of seedling. Seedlings were uprooted just before land preparation. The experimental field was ploughed crisscross twice by using tractor and major weeds were removed seven days before transplanting. FYM at 5-ton ha^{-1} was applied as the main source of organic manure in the experiment plot according to the treatment basis and uniformly incorporated into the soil. Urea, Di ammonium Phosphate, Muriate of Potash was the source of fertilizers used for supplying nitrogen, phosphorus and potassium respectively. The recommended doses of phosphatic and potassic fertilizers at the rate 60:40 kg ha^{-1} were calculated and weighed separately and applied as basal dose for all treatments. Similarly, required amount of nitrogen fertilizer was calculated separately for each plot based on the treatment allocated for that plot. 50% (60 kg ha^{-1}) 75% (90 kg ha^{-1}) 100% (120kg ha^{-1}) recommended dose of nitrogen were used. Full dose of phosphorus and potassium were applied at the time of final land preparation. Three split of nitrogen application were followed. One half was applied at the time of sowing and remaining one half in two split doses at tillering stage (30 DAS) and panicle initiation stage (50 DAS). Blue green algae (BGA) was applied on the field 10 days after transplanting at the rate of 9 kg ha^{-1} in the allocated plots.

Twenty-eight days old seedlings were transplanted in plots with two-three seedlings/hill maintaining 20cm x 20cm row to row and plant to plant distance. Gap fillings were done four days after transplanting to maintain the desired plant population in the experimental plots. Herbicide were not used for controlling weeds as puddling was followed properly. One hand weeding operations was done at thirty days after transplanting to reduce the competition between weeds and crop for nutrients, spaces light and moisture. Second light weeding was done at 45 (DAT) where weed density was found high. Sever infestation of Brown Plant Hopper (BPH) was seen just before time of panicle initiation stage at all experimented plots. The infestation was initiated from the leaves and insects suck the leaf and leaf sheath resulting yellowing, wilting and drying up in sever infestation. Pathological infestation of Brown Spot was seen during tillering stage of rice.

Irrigation was applied for puddling operations through motor operated pump nearby channel and maintained rainfall water for different operations. Bund of 0.5m height was made between individual plots to stagnate the rain water. The crop from the net plot area was harvested manually with the help of sickles. Harvested plants were left in-situ in the field for 3 days for sun drying. Thereafter, small handy bundles were tied, and threshing was done manually. The grains were cleaned by winnowing and weighted at their exact moisture content. Before threshing, total weight of above ground biomass was taken from net plot as biological yield.

2.4. Plant Parameter Studied

2.4.1. Biometric Observations

Plant height

Randomly selected and tagged 10 plants from different rows other than boarder row and destructive rows were used for the measurement of plant height at an interval of 7 days from 21 DAT up to harvesting. Plant height was taken from the base of the plant to the top of the panicle in cm, whichever is longer. Mean plant height was taken from the tagged main tillers of each hill.

No of tiller per hill

Tiller from randomly selected 10 hills in each growing stage were counted and average tiller per plant was calculated. Main stem was also included to calculate the total tiller per hill.

2.4.2. Yield Attributing Characters of Rice

Number of effective tiller per square meter

The number of effective tillers per m^2 was calculated for each plot just before harvesting the crop. The tillers having filled grains were recorded as effective tillers and the tillers without filled grains were recorded as non-effective tillers.

Panicle length

The randomly selected ten panicles from each hill were used to measure the panicle length and mean value is taken as panicle length in cm. The panicle length in cm was taken from the base of the rachis to the tip of the panicle.

Grain sterility percentage

Percentage of empty gains is determined by air temperature during the critical growing stages, namely at the time of meiosis (9-12 days before flowering) and flowering.

Total number of grains and unfilled grains per panicle was used to calculate sterility percentage as per given formula,

$$Sterility\ \% = \frac{No.of\ \ unfilled\ \ grains}{Total\ no.of\ \ grains} x100.$$

Number of grains / panicle

Total number of grains per panicle was counted manually from the panicles which were selected randomly from 10 hills of each plot. The mean of ten randomly selected panicles from plot were used to determine the number of grains per panicle.

Test weight

Thousand gains were selected randomly from the grain yield of each plot and weighed with the help of potable automatic electronic balance at about 14% moisture content. The thousand grains weight was expressed in gram (gm).

2.4.3. Measurement of Yields

Grain yield

The weight of grain from each net plot was recorded. The data was converted and reported as grain yield ha^{-1} as kg ha^{-1}. The moisture percentage of grains of each net plot was determined by moisture meter and final grain yield was adjusted at 14% moisture level by following formula [14]. The thousand grains weight was expressed in gram (gm).

$$\text{Grain yield } \left(\text{kg ha}^{-1}\right) \text{ at 14 \% moisture}$$
$$= \frac{(100 - MC)\,X\ \ plot\ \ yield\,(kg)\,x1000(m^2)}{(100 - 14)\,xA}$$

Where, MC = Moisture content of grain (%) just before weighing the bulk

Y = Net plot yield (kg)

A = Net plot area (m^2)

(100-MC) / (100-14) = Conversion factor for grain yield at 14% moisture content.

(1000) / A = Conversion factor for actual harvested area into hectare basis.

Straw yield

The straw obtained from the net plot area of each plots were sun dried for 3-4 days and weighed. The yields so obtained were translated into ton per hectare.

Grain: straw ratio

Grain: straw ratio was obtained by dividing grain yield by straw yield;

$$Grain : straw\ ratio = \frac{Grain\ yield\,(kg)}{Straw\ yield\,(kg)}.$$

Harvest index (HI)

Harvest index is the ratio of grain yield and the total above ground biomass which indicates the efficiency of plant to assimilate partition to the economic parts (example: rice grain). Higher the harvest index means plant is capable to deposit assimilates having economic importance from the source (leaf, leaf sheath, stem, flag leaf) to the panicle (sink) especially grain in case of cereals.

Harvest index (HI) was computed by dividing economic yield with the biological yield as per the following formula.

$$Harvest\ Index(HI).$$
$$= \frac{Economic\ \ yield\ (Grain\ yield)}{Biological\ \ yield\ (Grain\ yield + Staw\ yield)}$$

2.5. Statistical Analysis

Data were compiled and statistically analyzed by using MSTAT-C. Mean was separated at 5% level of significance, if the results vary significantly; Duncan's Multiple Range Test (DMRT) was used for comparing means [5]. The correlation analysis was performed between related variable using MS-Excel and SPSS (Statistical Package for Social Science).

2.6. Meteorological Data during Cropped Season

The experimental site lies in the sub- tropical humid climate belt of Nepal. The area has sub-humid type of weather condition with cool winter, scorching summer and distinct rainy season (Figure 1).

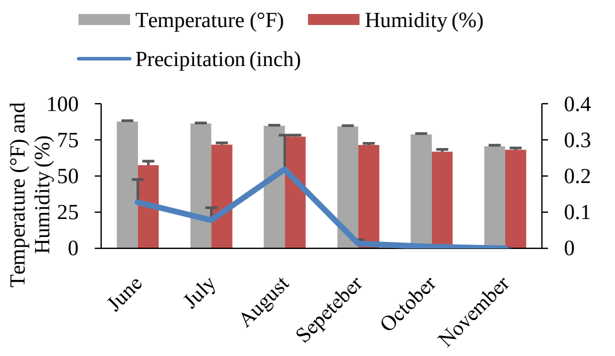

Figure 1. Meteorological data during cropped season, Rupandehi, Nepal, 2015

3. Result

3.1. Biometric Observations

3.1.1. Plant Height

Influence of different combination of nitrogen sources was found in plant height. Maximum plant height was observed in treatment 4 (75%RDN+FYM +BGA) i.e. 96.13 cm followed by T7 (100%RDN+FYM +BGA) whereas minimum plant height was recorded in treatment 1 (50%RDN+ FYM+BGA) i.e. 87.80 cm (Table 2).

Table 2. Effect of different combination of Nitrogen source on plant height and panicle length of rice at Rupandehi, Nepal, 2015

Treatments	Plant height (cm)	Panicle length (cm)
50%RDN†+FYM +BGA	87.80[c]	21.70
75%RDN+FYM	89.22[bc]	21.48
75%RDN + BGA	90.25[bc]	20.67
75%RDN+FYM +BGA	96.13[a]	24.92
100% RDN+ FYM	90.03[bc]	20.35
100% RDN + BGA	91.63[b]	21.63
100% RDN + FYM +BGA	95.52[a]	23.18
F test	**	ns
SEM (±)	1	1.4
LSD (0.05)	24.05	7.578
Grand mean	91.511	5.59
C.V (%)	1.88	21.99

† RDN= Recommended dose of nitrogen; FYM= Farmyard manure; BGA= Blue green algae
abc Values with different superscript within each column differs (**p<0.01).

3.1.2. Panicle Length

The randomly selected ten panicles from each hill were used to measure the panicle length and mean value is taken as panicle length in cm. The panicle length in cm was taken from the base of the rachis to the tip of the panicle. The maximum panicle length was recorded in T4 (75%RDN+FYM+BGA) i.e. 24.92 cm whereas minimum panicle length was observed in T5 (100%RDN+FYM) (Table 2).

3.2. Yield Attributing Characters of Rice

3.2.1. Effective Tiller Per Square Meter

Highest no. of effective tillers was obtained in T4 (75%RDN+FYM +BGA) i.e. 345.6 followed by T7 (100%RDN+FYM +BGA) while lowest no. of effective tillers was observed in T1 (50%RDN+FYM +BGA) i.e. 256.7 followed by T2 (75%RDN+FYM) (Table 3).

Table 3. Effect of different combination of nitrogen source on effective tillers per square meter of Rice at Rupandehi, Nepal, 2015

Treatments	Effective tillers per square meter
50%RDN†+FYM +BGA	256.7[c]
75%RDN+FYM	271.7[bc]
75%RDN + BGA	274.2[bc]
75%RDN+FYM +BGA	345.6[a]
100% RDN+ FYM	281.9[bc]
100% RDN + BGA	287.5[bc]
100% RDN + FYM +BGA	307.5[ab]
F test	**
SEM (±)	13.2
LSD (0.05)	40.69
Grand mean	289.272
C.V (%)	7.44

† RDN= Recommended dose of nitrogen; FYM= Farmyard manure; BGA= Blue green algae
abc Values with different superscript within a column differs (**p<0.01).

3.2.2. Filled Grain Per Panicle

Greater no. of filled grains per panicle was recorded in T4 (75%RDN+ FYM+BGA) i.e. 180.9 and lowest no. of filled grains per panicle was recorded in T1 (50%RDN+FYM+BGA) (Table 4).

3.2.3. Flag Leaf Length

The flag leaf length was recorded from each hill of block and mean flag leaf length in cm was calculated to analyse the result. Maximum flag leaf length was found in T3 and T4 whereas minimum flag leaf length was observed in T6 (100% RDN+ BGA) i.e. 28.77 cm (Table 4).

3.2.4. Test Weight

The maximum test weight was observed in T4 (75%RDN+FYM+BGA) i.e. 12.35 gm and minimum test weight was observed in treatment 2 i.e.10.8 gm (Table 4). There was no significant difference in the test weight between different combinations of nitrogen sources because test weight is governed by varietal character rather than fertilizer application.

Table 4. Effect of different combination of nitrogen source on flag leaf length, filled grain and test weight of rice at Rupandehi, Nepal, 2015

Treatments	Flag leaf length (cm)	Filled grain/panicle	Test weight(gm)
50%RDN[†]+FYM +BGA	30.22	133.1[d]	11.43
75%RDN+FYM	29.63	138.3 [cd]	10.80
75%RDN + BGA	30.78	149.9[bcd]	12.02
75%RDN+FYM +BGA	30.78	180.9 [a]	12.35
100% RDN+ FYM	29.96	147.2[bcd]	12.14
100% RDN + BGA	28.77	161.4[abc]	11.63
100% RDN + FYM +BGA	30.67	170.2[ab]	12.34
F test	Ns	**	Ns
SEM (±)	1.806	7.806	1.441
LSD (0.05)	5.563	24.05	4.441
Grand mean	30.117	154.440	6.10
C.V (%)	3	8.75	11.816

[†] RDN= Recommended dose of nitrogen; FYM= Farmyard manure; BGA= Blue green algae
[abc] Values with different superscript within each column differs (**p<0.01).

3.3. Measurement of Yields

3.3.1. Grain Yield

Higher grain yield was recorded in treatment 4 (75%RDN +FYM+BGA) i.e. 4.787-ton ha^{-1} followed by treatment 7 (100%RDN +FYM+BGA). The minimum grain yield was recorded in T1 (50%RDN +FYM+BGA) i.e. 3.357-ton ha^{-1} which is in par with T5 (100%RDN +FYM) i.e. 3.490-ton ha^{-1} (Table 5).

3.3.2. Straw Yield

The straw obtained from the net plot area of each plots were sun dried for 3 days and weighed. The yields so obtained were translated into ton per hectare. Maximum straw yield was recorded in T4 (75%RDN +FYM+BGA) i.e. 9.07-ton ha^{-1} and minimum straw yield in T1 (50%RDN +FYM+BGA) i.e. 6.763-ton ha-^{1} (Table 5).

3.3.3. Harvest Index (HI)

Higher harvest index was recorded in T4 (75%RDN +FYM+BGA) i.e. 0.3467 and lower harvest index was recorded in T5 (100%RDN +FYM) i.e. 0.3152 (Table 5). There was no significant difference in harvest index between different treatments because both grain yield and biological yield varied side by side with different combination of nitrogen sources.

Table 5. Effect of different combination of nitrogen sources on economic yield, straw yield and harvest index of rice at Rupandehi, Nepal, 2015

Treatments	**Grain yield(ton/ha)**	**Straw yield(ton/ha)**	**HI**
50%RDN[†]+FYM +BGA	3.357[c]	6.763[c]	0.3320
75%RDN+FYM	3.57[bc]	7.397[bc]	0.3285
75%RDN + BGA	3.930[abc]	8.027[abc]	0.3295
75%RDN+FYM+BGA	4.787 [a]	9.017[a]	0.3467
100% RDN+ FYM	3.490 [c]	7.587[abc]	0.3152
100% RDN + BGA	4.180[abc]	8.147[abc]	0.3388
100% RDN + FYM +BGA	4.513[ab]	8.790[ab]	0.3391
F test	*	*	Ns
SEM (±)	0.2966	0.4698	0.02582
LSD (0.05)	0.9141	1.447	0.07956
Grand mean	3.975	7.961	0.333
C.V (%)	12.93	10.22	12.82

[†] RDN= Recommended dose of nitrogen; FYM= Farmyard manure; BGA= Blue green algae; HI= Harvest Index
[abc] Values with different superscript within each column differs (*p<0.05).

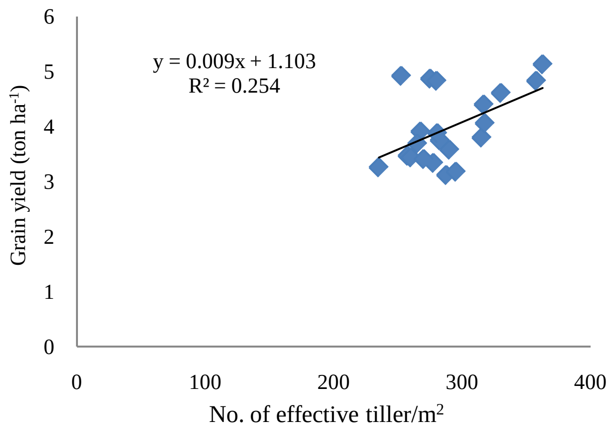

Figure 2. Relationship between grain yield and number of effective tiller per square meter of rice at Rupandehi, Nepal, 2015

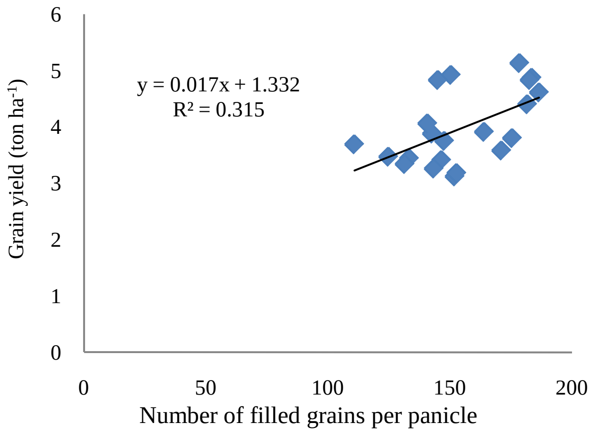

Figure 3. Relationship between grain yield and number of filled grains per panicle of rice at Rupandehi, Nepal, 2015

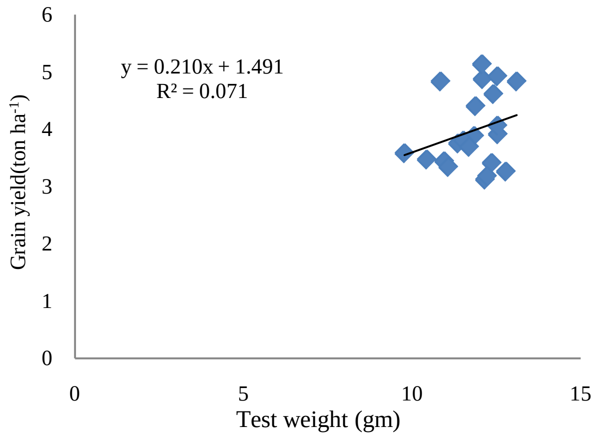

Figure 4. Relationship between grain yield and test weight of rice at Rupandehi, Nepal, 2015

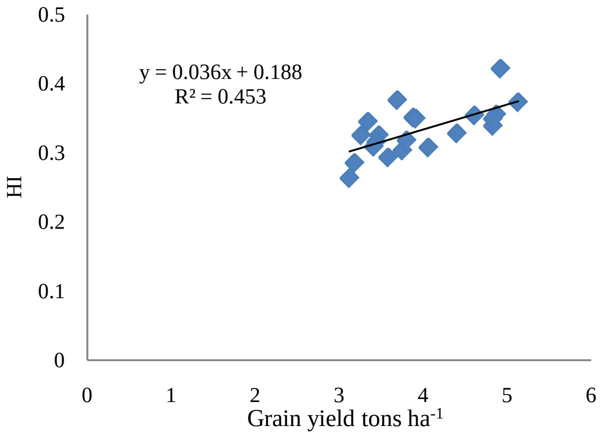

Figure 5. Relationship between grain yield and harvest index of rice at Rupandehi, Nepal, 2015

3.4. Correlation Regression Studied

To assess relationship between growth parameters, yield attributing traits and grain yield, simple correlation coefficients were worked out. The positive correlation between grain yield and yield attributing traits like number of effective tillers per square meter (R^2=0.254) (Figure 2), number of filled grains per panicle (R^2=0.315) (Figure 3) and test weight (R^2=0.071) (Figure 4). Similarly, the relationship between grain yield and harvest index was observed positively correlated and significant (R^2=0.453) (Figure 5).

The number of effective tillers/m^2 contribute approximately 25.4 % (R^2=0.254) on the grain yield. Whereas the remaining 74.60% increase in grain yield may be due to variable other than effective tillers /m^2. Similarly, approximately 31.5% (R^2=0.315) contribution was given by number of filled grains/panicles on grain yield. And the remaining 68.50% part was contributed by the variables other than filled grains/panicle. Again, test weight input about 7.1% (R^2=0.071) share on grain yield and left over 92.9% increase in grain yield was due to other variables except test weight. Whereas, grain yield contributed about 45.3% (R^2=0.453) towards increase in the harvest index. And the remaining 54.70% contribution for increasing yield was given by the variable other than harvest index.

4. Discussion

Combination of 75%recommended dose of nitrogen, BGA and FYM was found to be superior in maximum number of tillers per square meter but was statistically par with 100% RDN, BGA and FYM combination. Superiority of 75% RDN, BGA and FYM compared to RDN and BGA or FYM combination might be due to both bio- fertilizer and organic source used. Farmyard manure slowly releases the nitrogen which is beneficial for algal growth, providing adequate amount of nitrogen. Improvement of number of tiller/hill was observed due to the addition of BGA with applied nitrogen [1]. Our findings showed the superiority of 75% of RDN, BGA and FYM combination over 100%RDN, BGA and FYM. BGA contribution was found better in plots treated with lower level of nitrogen in terms of tiller initiation [1]. Also, no significant change in number of tillers/hill was found due to applied treatment of different rates of recommended NPK dose and BGA in first cropping season [1].

In our study, combination of 75%RDN from urea, BGA and FYM also showed greater plant height which was statistically par with 100%RDN, BGA and FYM but were significantly different from other treatments. This might be due to the combined effect of both FYM and BGA that slowly releases nutrient into the soil at various growth stages along with required amount of nitrogen from urea. This result confirms with the findings of [9] and [22].

Not all the grains present in the panicle are filled. Number of unfilled grains in a panicle depends on genotype, growing environment and the nutrient provided. Significantly low filled grain/panicle was observed in combination of 50%RDN, BGA and FYM. Higher filled grain per panicle was observed in combination of 75% RDN, BGA and FYM as compared to other treatments while it was statistically par with 100%RDN, BGA and FYM and 100%RDN and BGA. The higher filled per panicle might be due to the application of BGA and FYM along with required amount of nitrogen from inorganic fertilizer (excessively low nitrogen might not be good). Our finding is supported by [1] and [20] who found that application of bio-organic sources had noticeable influence on yield attributes and combined use of BGA produced highest number of effective tillers per hills and filled grain per panicle.

Grain and straw yield was also found higher in 75%RDN, BGA and FYM while it was significantly par with 100%RDN, BGA and FYM combination treatment. Also, no significant difference was observed between the treatments that include Blue green algae and adequate amount of nitrogen (75-100%) from inorganic fertilizer. This might suggest that blue green algae along with adequate amount of nitrogen is essential to boost yield of rice variety-Sampurna. Our results are in line with findings of [1].

Our findings showed an increase in plant height, number of effective tillers, filled grain per panicle, and grain and straw yield when 75%RDN, BGA and FYM was applied. Integrated use of inorganic sources (adequate level), organic and bio-fertilizers seems beneficial compared to only combination of inorganic and FYM (organic) or inorganic and BGA (bio-fertilizer). Our finding is in line with [19]. According to them the rice characteristics increased significantly with increase in NPK level up to 75% RDF while 100% RDF were at par (statistically) at all characteristics beside number of effective tillers. Along with, role of organic and biofertilizer source is important [7].

5. Conclusion

Combination of 75% recommended dose of nitrogen, FYM and BGA was found higher than the other combinations of nitrogen sources followed by the combination of 100% recommended dose of nitrogen, FYM and BGA regarding the yield and growth attributes of rice while statistical significant was not observed. This might be due to the integration of organic sources, bio-fertilizers and adequate nitrogen from inorganic source that improves the growth and development of rice. Also, yield was improved with the application of BGA along with adequate amount of inorganic nitrogen. Hence, from our findings we conclude that application of combination of 75% recommended dose of nitrogen, FYM and BGA is better for rice variety-Sampurna under Rupandehi district, Nepal condition and. This combination might minimize the cost of production for farmers as well as reduces the use of inorganic fertilizer along with increasing yield.

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References

[1] Begum, Z. N., Mandal, R., & Islam, S. (2009). Effect of blue-green algae and urea-N on growth and yield performance of traditional variety of rice. Journal of Phytological Research, 22: 211-214.

[2] Fageria, N. K., & Baligar, V. C. (1997). Response of common bean, upland rice, corn, wheat, and soybean to soil fertility of an Oxisol. Journal of Plant Nutrition, 20(10), 1279-1289.

[3] Fleming, H., & Haselkorn, R. (1973). Differentiation in Nostoc muscorum: nitrogenase is synthesized in heterocysts. Proceedings of the National Academy of Sciences, 70(10), 2727-2731.

[4] Gately, T.F. and Kelly, D. (1987). Sources of nitrogen for spring barley. Soils and Grassland Production Research Report, pp 27-8. Dublin. A Foras Taluntais.

[5] Gomez, K.A. & Gomez, A. A (1984). Statistical procedures for agricultural research (2 ed.). John wiley and sons, NewYork, 680p.

[6] Howarth, R. W. (2008). Coastal nitrogen pollution: a review of sources and trends globally and regionally. Harmful Algae, 8(1), 14-20.

[7] Imade, S. R., Thanki, J. D., & Gudadhe, N. N. (2015). Integrated effect of organic manures and inorganic fertilizers on productivity, NPK uptake and profitability of transplanted rice. Research on Crops, 16(3), 401-405.

[8] International Rice Research Institute (2013). The massive benefits of global rice research. Retrieved in June 9, 2016 from http://irri.org/news/media-releases/the-massive-benefits-of-global-rice-research.

[9] Jat, A. L., Srivastava, V. K., & Singh, R. K. (2015). Effect of crop-establishment methods and integrated nitrogen management on productivity of hybrid rice (Oryza sativa)–wheat (Triticum aestivum) cropping system. Indian Journal of Agronomy, 60(3), 341-346.

[10] Kaini, B.R. (2004). Increasing crop production in Nepal. In: D.P. Sherchan, K. Adhikari, B.K. Bista and D. Sharma (eds) Proceedings of the 24th National Summer Crops Research Workshop in Maize Research and Production in Nepal held in June 28-30, 2004 at NARC, Khumaltar, Lalitpur, Nepal.pp.15-19.

[11] MOAC (2013). Statistical information on Nepalese Agriculture, Kathmandu: Ministry of Agriculture and Cooperatives/Agribusiness Promotion and Statistics Division.

[12] Muthayya, S., Sugimoto, J. D., Montgomery, S., & Maberly, G. F. (2014). An overview of global rice production, supply, trade, and consumption. Annals of the New York Academy of Sciences, 1324(1), 7-14.

[13] Pandey, N., Upadhyay, S. K., Joshi, B. S., & Tripathi, R. S. (2001). Integrated use of organic manures and inorganic to fertilizers for the cultivation of low land rice in vertisol. Indian Journal of Agricultural Research, 35(2), 112-114.

[14] Paudel, M.N. (1995). Nutrient management for Sulphan buri- 90 rice variety in acid sulfate soil with green leaf manure. M.Sc. Thesis, Asian Institute of Technology, Bankok, Thailand. Pp 23-51.

[15] Radwan, F. I., El Seoud, I. A., & Badr, E. A. (2008). Response of Two Rice Cultivars to Blue Green Algae, A-Mycorrhizae Inoculation and Mineral Nitrogen Fertilizer. Middle Eastern and Russian Journal of Plant Science and Biotechnology, 2(1), 29-34.

[16] Sahrawat, K. L. (2000). Macro-and micronutrients removed by upland and lowland rice cultivars in West Africa. Communications in Soil Science and Plant Analysis, 31(5-6), 717-723.

[17] Saleque, M. A., Naher, U. A., Islam, A., Pathan, A. B. M. B. U., Hossain, A. T. M. S., & Meisner, C. A. (2004). Inorganic and organic phosphorus fertilizer effects on the phosphorus fractionation in wetland rice soils. Soil Science Society of America Journal, 68(5), 1635-1644.

[18] Sapkota, A., Poudel, S., Subedi, U., Shrivastav, R., Gairhe, J. J., Khanal, S., & Pande, K. R. (2015). Effect of Mulching and Different Doses of Phosphorous in Cowpea (Vigna unguiculata L.) Yield and Residual Soil Chemical Properties at Bhairahawa, Nepal. World, 3(5), 163-173.

[19] Shivaji, S., Singh, S. P., Neupane, M. P., & Meena, R. K. (2014). Effect of NPK levels, BGA and FYM on growth and yield of rice (Oryza sativa L.). Environment and Ecology, 32(1A), 301-303.

[20] Singh, D. A. S. H. R. A. T. H., & Kumar, A. N. I. L. (2014). Effect of sources of nitrogen on growth yield and uptake of nutrients in rice. Annals of Plant and Soil Research, 16(4), 359-361.

[21] Song T., Martensson L., Eriksson T., Zheng W., Rasmussen U. (2005): Biodiversity and seasonal variation of the cyanobacterial assemblage in a rice paddy field in Fujian, China. The Federation of European Materials Societies Microbiology Ecology, 54: 131-140.

[22] Sujathamma, P., & Reddy, D. S. (2004). Growth yield and nitrogen uptake of low land rice as influenced by integrated nitrogen management. Indian Journal of Agricultural Research, 38(4), 268-272.

[23] Taddesse, E. (2009). Rice (*Oryza sativa* L.) cultivars: Morphology and Classification part II. Experimental Station Bulletin 66. Addis Ababa University, College of Agriculture, Dire Dawa (Ethiopia). 73p.

[24] Tisdale, S.L. & Nelson, W.L. (1984). Soil Fertility and Fertilizers, Third Ed. Pp: 68-73. McMillan Publ. Co., Inc., New York.