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STUDIES ON THE EFFECT OF VARIOUS LEVELS OF NITROGENOUS FERTILIZER ALONG WITH SOME NITROGEN FIXING BLUE GREEN ALGAE ON SOME YIELD ATTRIBUTES OF RICE VARIETIES CV. PUSA 1509 AND PUSA SHARBATI

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ABSTRACT

Nitrogen is indispensible ingredient of animal food and comes initially from plant. In fact, plant converts the nitrogen of soil in two forms suitable for nutrition of animals. After water, nitrogen is the second limiting factor for plant growth in many fields and deficiency of this element is met by fertilizers. The excessive use of chemical fertilizer has generated several environmental issues. These problems can be tackled by use of Bio-fertilizers. Bio-fertilizers are different from Chemical fertilizers. Bio -fertilizer on the application remains in soils, multiply and keep benefiting the growing crops. Blue green algae (BGA) or Cyanobacteria, the free-living photosynthetic N-fixing organism, are distributed worldwide and contribute to the soil fertility in many agricultural ecosystem. Cyanobacteria function as a Bio-fertilizer due to the property of nitrogen fixation (conversion of molecular nitrogen into nitrogen compound). The mass production of Cyanobacteria is much cheaper and easy than that of conventional chemical fertilizer and their inorganic requirement is very simple. To test the efficacy of nitrogenous fertilizer along with BGA on the yield attributes of rice, a field experiment was conducted with rice variety Pusa 1509 and Pusa sharbati. Two fields of 2.0 m into 3.0 m were prepared one without BGA as control and other with BGA. For this field experiment recommended dose of BGA is 10 kg/ ha after the transplantation of rice seedlings. Inoculates contains the mixture of *Gloeocapsa, Plectonema, Oscillatoria, Anabaena, Nostoc, Cylindrospermum, Scytonema, Calothrix, Anabaenopsis, Aulosira, Eisherella* etc. As compared with control tillers were seen after 80 days, food grains were thick, elongated and healthy and 10-30 percent grain yield found to be increased over control. The observation clearly indicates that the BGA can be the good option to increase the growth and crop production in Rice.

Keywords : Bio-fertilizers, BGA, Rice plant, productivity, BGA, cyanobacteria.

Introduction

Rice is vital to more than half the world's population. It is most important food grain in the diets of hundreds of millions of Asians, Africans and Latin Americans living in the tropics and subtropics. In these areas, population increase is high and Rice will continue to be their primary source of food.

Over 90 percent of the world's Rice is produced and consumed in Asia-pacific region. The Asia-pacific region, where more than 56 percent of the world's population live, adds 51 million more rice consumers annually. The irrigated Rice area currently occupies about 56 percent of the area and contributes 76 percent of the total production. Crop yield is increased by adopting new farming methods and improvement in varieties used besides improving soil conditions. The continuous cropping of rice, either singly or in combination has brought about a decline in soil health through nutrient deficiencies, nutrient toxicity, salinity and overall physical deterioration of the soil.

There is no reliable evidence that higher plants can utilize molecular nitrogen or gaseous nitrogen of the atmosphere directly. For rooted green plants nitrogenous compounds absorbed from the soil serve as the sole source of nitrogen, ammonium nitrogen, organic nitrogen and molecular nitrogen (Ahmed, S.U. and Kalita, M.C. 2002). The utilization of all the four forms of nitrogen is confined to certain groups or bacteria and algae. Bio-fertilizer is defined biologically active products of bacteria, algae and fungi separately or in combination, which may help in biological nitrogen fixation for the benefit of plant (Chaudhary *et al*., 2007). The need for the use of Bio-fertilizer has arisen primarily for two reasons. The increase in the of fertilizer lead to damage of soil texture and other environmental problems.

Therefore, the use of Bio-fertilizer is recommended by the agricultural scientists (Berla, 2013). The application of Bio-fertilizer is both economical as well as environmental friendly. The occurrence of bio fertilizer in rice growing soil

is of great significance due to their ability to fix atmospheric nitrogen which become available for utilization by the growing rice plant (Begum, 2008). The utilization of blue green algae as a Bio-fertilizer for rice is very promising (Issa *et al*., 2014). A judicious use of these algae could provide, to the country's entire rice hectare, as much nitrogen as obtained from 15-17 lakh tones of urea. BGA Bio-fertilizer should be used every rice crops as a kind of insurance to the crop yield as well as to give a stop to the deterioration of soil physico-chemical properties (Rossi, 2017).

Material and Methods

To study the effect of different levels of Nitrogen fertilizer along with BGA (Blue green algae) on yield, its attributes two popular hybrid varieties of *Oryza sativa Linn.* (Rice) viz., Pusa 1509 and Pusa sharbati. The site chosen for this trial was also tarai region of Bareilly, a place with relatively humid climate. A block of land was divided in 30 plots of size 5x3 sq. M. along with different levels of N fertilizer and BGA in basal form concurrently. The different levels of treatments of nitrogenous fertilizers and BGA are summarised as under:-

Nitrogen level	+	BGA
I. 0 kg/ha	+	0 kg
II. 0 kg/ha	+	12.5 kg
III. 40 kg/ ha	+	12.5 kg
IV. 80 kg/ ha	+	12.5 kg
V. 120 kg/ha	+	12.5 kg
VI. 160 kg/ha	+	12.5 kg

Date schedule

Date of sowing	-	26-07-2018
Date of transplanting	-	15-08-2018
Date of harvesting	-	08-11-2018
Date of thrashing	-	15-11-2018

Soil characteristics : The soil of the experimental field was sandy. Since the field crop are greatly influenced by the physical and chemical properties of soil, the composite soil samples from the 0-15 cm and 15-30 cm depths were collected, air dried processed and used for chemical analysis. Before sowing soil has low to medium fertility status with low organic content, available N, available P and S were in low range, available K was medium in range and neutral to slightly alkaline in nature.

Cropping history of experimental field : The experimental field had only one crop of rice annually during proceeding years. During the years under experimentation, the land was fallow during Rabi season and the experimental crop of *Oryza sativa Linn.* was sown in Kharif season.

Experimental Details

Design and Layout : Field experimental was conducted during kharif season of 2019-2020 in randomized block with three replications. Other details are as under -

Variety - *Oryza sativa Linn.*

Plot size - 5.0 m. into 3.0 m.

Row to row spacing - 40 cm.

Plant to plant spacing - 15 cm.

Number of rows per plot - 14

Number of rows harvested per plot - 10

The samples collected and were tested to determine yield and its yield attributes.

Plant Height: The plant was measured on four hill (one each in 3rd row) located at 4 corners of the plot. The height of individual hill was measured with the help of a meter scale from the base of the plant to the tip of the tallest plant part. The plant height was measured at maturity.

Productive Tillers Number : Number of productive tillers per plant were counted at maturity.

Spikes Per Panicle Number : Number of spikes per panicle was counted at maturity.

1000 Seed Weight : Samples of 100 grain were drawn plot wise from the bulk pf 16 hills samples filled grain and their weight recorded after uniform drying to about 14 percent. The weight of these 100 grain then multiplied by 10 to get the 1000 seed weight.

Grain Yield : Grain yield/plot (in kg) will be recorded in treatment as well as in control and converted into quintal per hectare.

Results

Nitrogen is an indispensable ingredient of animal food and comes initially from plants. For rooted green plants nitrogenous compounds absorbed from the soil serve as the sole source of nitrogen. The forms of nitrogen available to such plants are nitrate, ammonium nitrogen, organic nitrogen and molecular nitrogen. The utilization of all the four forms of nitrogen is confined to certain groups or bacteria and algae.

The Blue green algae are primitive plants, having certain resemblance to bacteria but better evolved by virtue of their ability to synthesize their own food as green plants. Their occurrence in rice growing soil is of great significance due to their ability to fix atmospheric nitrogen which become available for utilization by the growing rice plant. This is a unique feature for partially meeting the oxygen requirement of the roots of the plant in an anaerobic environment of the water-logged soil. The levels and seeds obtained after these treatments were analysed for there different yield attributing characters.

Different levels of Nitrogen fertilizer along with Blue green algae affect the plant height of *Oryza sativa Linn.* (cv. Pusa 1509 and Pusa sharbati).

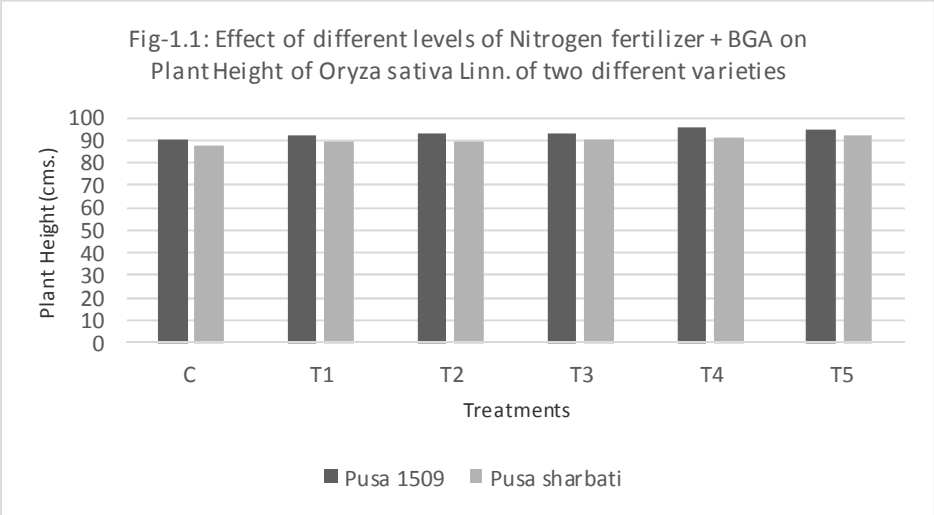
The data pertaining to plant height are summarized in table 1.1 along with analyses of variances. The significant difference in plant height at maturity due to different levels of N fertilizer along with BGA were observed in both the varieties, significant increase in plant height was found in all the treatments over control ranging from 2.20 to 5.51 and 1.48 to 4.55 percent in varieties Pusa 1509 and Pusa sharbati, respectively. Height of plant increased significantly with increasing dose of nitrogen fertilizer from 0-120N/ha along with BGA (Blue green algae) in variety Pusa 1509, while in variety Pusa sharbati it increased up to the level of 160 kg/ha.

Table 1.1 : Plant height of *Oryza sativa Linn.* at maturity as affected by different levels of nitrogen fertilizer + BGA.

Nitrogen level + BGA	Varieties		Total	Mean
	Pusa 1509	Pusa sharbati		
C 0 kg ha^{-1}	90.60	87.80	178.48	89.20
T1 0 kg ha^{-1} + 12.5 kg	92.60	89.10	181.70	90.85
T2 40 kg ha^{-1} + 12.5 kg	93.20	89.60	182.80	91.40
T3 80 kg ha^{-1} + 12.5 kg	93.30	90.20	183.50	91.75
T4 120 kg ha^{-1} + 12.5 kg	95.60	91.70	187.30	93.65
T5 160 kg ha^{-1} + 12.5 kg	95.00	91.80	186.80	83.40
Total	560.30	540.20		
Mean	93.38	90.03		

Analysis of variance:

Source of variation	Degree of freedom	Sum of squares	Mean squares	Variance Ratio 'F'
Levels	5	82.5208	16.5042	216.5022**
Varieties	1	100.993	100.993	1324.83
Error	22	1.67708	0.076200	
Total	35	271.531		



Number of productive tillers/plant of *Oryza sativa Linn.* (cv.Pusa 1509 and Pusa sharbati) as affected by different levels of N fertilizer along with BGA.

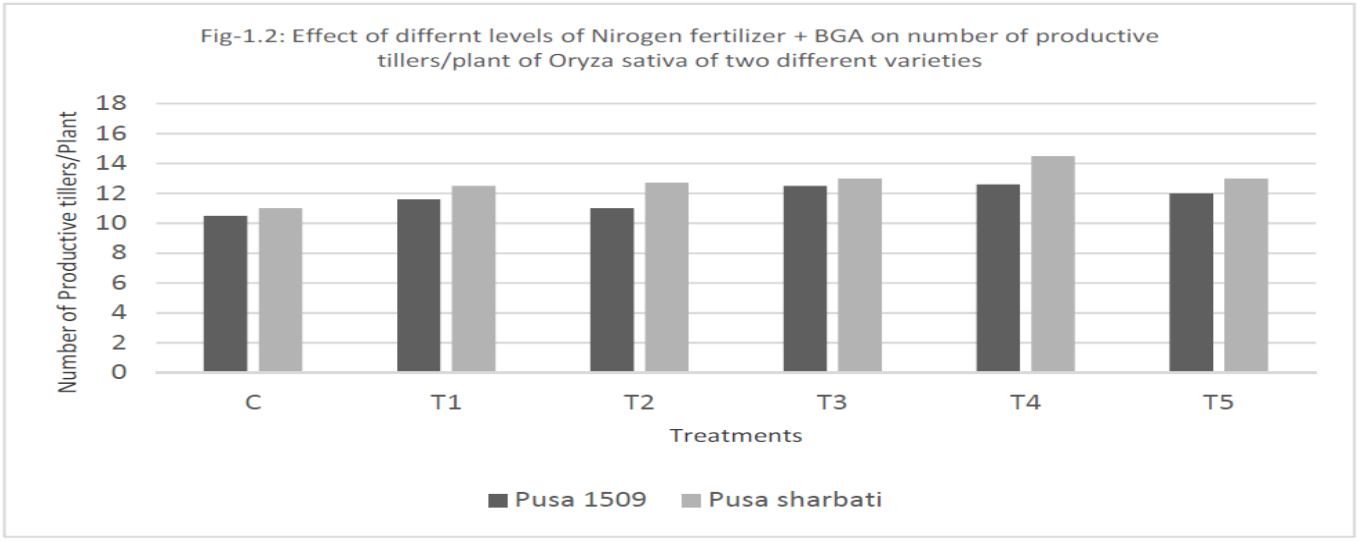
Total number of productive tillers per plant was affected significantly due to different levels of nitrogen fertilizer along with BGA in both the varieties (Pusa 1509 and Pusa sharbati) [Table 1.2]. The treatments consisting of different levels of N fertilizer and BGA resulted in significant increase in number of productive tillers/plant over control (11.5 and 10.6 in variety Pusa 1509 and Pusa sharbati respectively). in both the varieties 120 kg N/ha along with BGA produced significantly higher number productive tillers per plant (16.70 in variety Pusa 1509 and 16.20 in Pusa sharbati) followed by 160 kgN/ha along with BGA (16.20 in var. Pusa 1509 and 15.90 in var. Pusa sharbati).

Table 1.2 : Number of productive tillers/plant of *Oryza sativa Linn.* maturity as affected by different levels of nitrogen fertilizer + BGA.

Nitrogen level + BGA	Varieties		Total	Mean
	Pusa 1509	Pusa sharbati		
C 0 kg ha^{-1}	11.50	10.60	22.10	11.05
T1 0 kg ha^{-1} + 12.5 kg	13.20	12.50	25.70	12.85
T2 40 kg ha^{-1} + 12.5 kg	14.83	13.40	28.23	14.12
T3 80 kg ha^{-1} + 12.5 kg	15.70	15.60	31.30	15.65
T4 120 kg ha^{-1} + 12.5 kg	16.70	16.20	32.90	16.45
T5 160 kg ha^{-1} + 12.5 kg	16.20	15.90	32.10	16.05
Total	88.13	84.20		
Mean	14.69	14.30		

Analysis of Variance:-

Source of Variation	Degree of freedom	Sum of square	Mean Square	Variance ratio 'F'
Levels	5	133.099	26.6198	579.1322**
Varieties	1	3.86388	3.86388	84.0613
Error	22	1.01123	0.04600	
Total	35	226.303		



Number of spikes/panicle (main shoot) of *Oryza sativa Linn.* (cv.Pusa 1509 and Pusa sharbati) as affected by different levels of N fertilizer along with BGA.

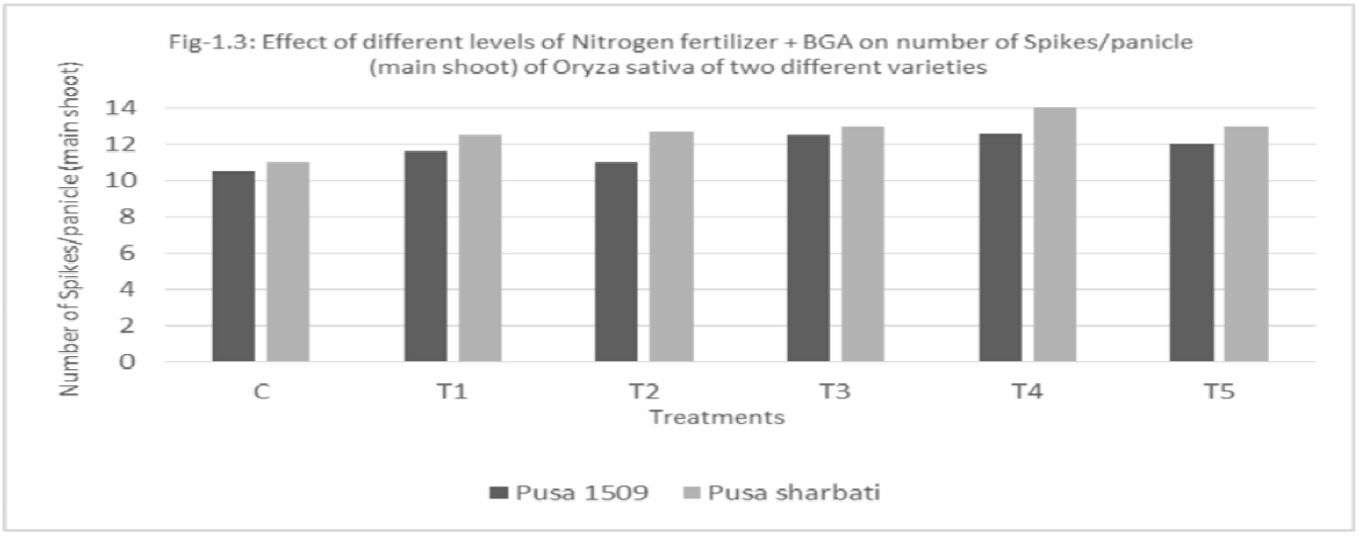
Total number of spikes/panicle were affected significantly due to different levels of N fertilizer along with BGA in both the varieties (Pusa 1509 and Pusa sharbati) [Table 1.3]. The treatments consisting of N fertilizer along with BGA resulted in significant increase in number of spikes/panicle over control in both the varieties. Nitrogen application along with BGA increased the number of spikes/panicle significantly upto 120 kgN/ha along with BGA followed by 160 kgN/ha along with BGA in both the varieties. In both the varieties 120 kg N/ ha along with BGA produced significantly higher number of spikes/panicle(12.60 in variety Pusa 1509 and 14.50 in var. Pusa sharbati). The value between the treatment T3 and T4 is found non significant.

Table 1.3 : Number of spikes/panicle (main shoot) of *Oryza sativa Linn* as affected by different levels of nitrogen fertilizer + BGA

Nitrogen level +BGA	Varieties		Total	Mean
	Pusa 1509	Pusa sharbati		
C 0 kg ha^{-1}	10.50	11.00	21.50	10.75
T1 0 kg ha^{-1} + 12.5 kg	11.60	12.50	24.10	12.05
T2 40 kg ha^{-1} + 12.5 kg	11.00	12.70	23.70	11.85
T3 80 kg ha^{-1} + 12.5 kg	12.50	13.00	25.50	12.75
T4 120 kg ha^{-1} + 12.5 kg	12.60	14.50	27.10	13.55
T5 160 kg ha^{-1} + 12.5 kg	12.00	13.00	25.00	12.50
Total	70.20	76.70		
Mean	11.70	12.78		

Analysis of Variance:

Source of variation	Degree of freedom	Sum of squares	Mean squares	Variance ratio 'F'
Levels	5	26.7134	5.34268	85.51318**
Varieties	1	10.563	10.563	169.068
Error	22	1.37451	0.0625	
Total	35	131.428		



1000 seed weight of *Oryza sativa* Linn (cv.Pusa 1509 and Pusa sharbati) as affected by different levels of N fertilizer along with BGA.

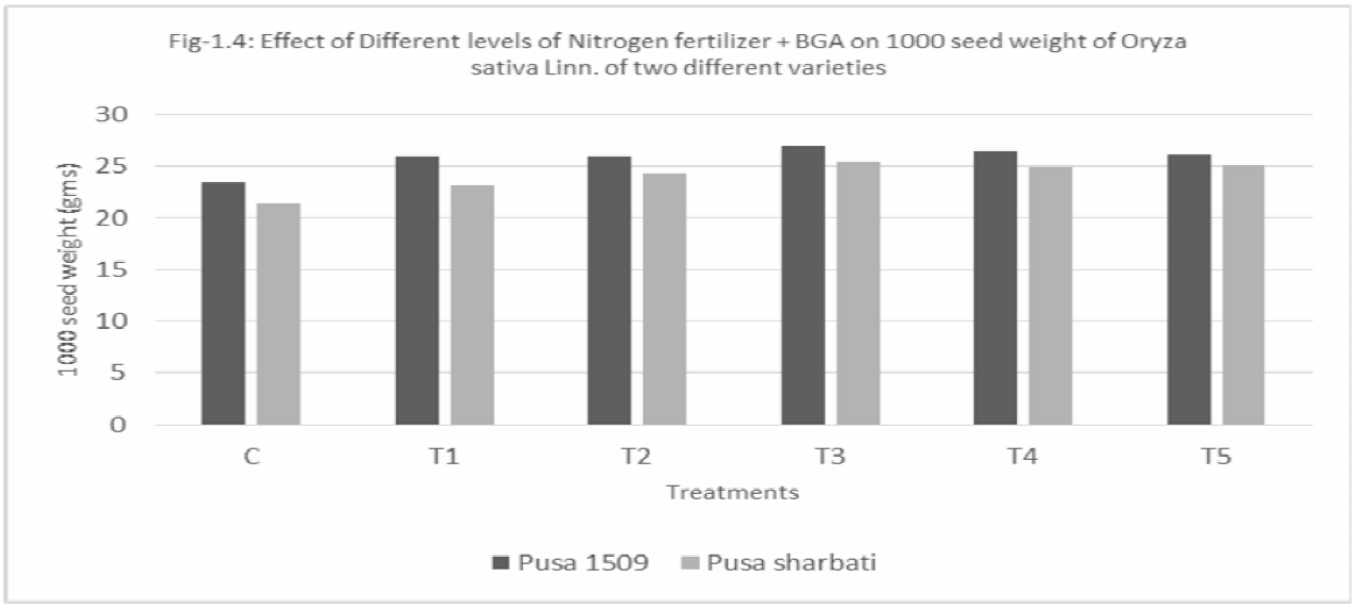
Test weight data of Rice varieties Pusa 1509 and Pusa sharbati presented in Table1.4 along with analysis of variance reflects that it increase significantly due to different levels of N fertilizer along with BGA in both the varieties. Percentage increase in weight of rice seeds are maximum with application of 120 kg N/ha along with BGA (15.14%) followed by treatment T5 (11.17%), T3 (12.88%), T2 (11.04%), T1 (10.83%) in variety Pusa 1509 and 19.14% followed by T5 (17.36%), T3 (16.94%), T2 (13.67%), T1 (8.33%) in variety Pusa sharbati. However, the difference between the control and T5 and T1 and T4 and T2 and T4 are found non significant.

Table 1.4 : 1000 seed weight (gms) of *Oryza sativa* Linn. As affected by different levels of nitrogen fertilizer + BGA

Nitrogen level + BGA	Varieties		Total	Mean
	Pusa 1509	Pusa sharbati		
C 0 kg ha^{-1}	23.44	21.36	44.80	22.40
T1 0 kg ha^{-1} + 12.5 kg	25.98	23.14	49.12	24.56
T2 40 kg ha^{-1} + 12.5 kg	26.03	24.28	50.31	25.16
T3 80 kg ha^{-1} + 12.5 kg	26.99	25.45	52.44	26.22
T4 120 kg ha^{-1} + 12.5 kg	26.46	24.98	51.44	25.22
T5 160 kg ha^{-1} + 12.5 kg	26.06	25.07	51.13	25.57
Total **Mean**	154.96 25.83	144.28 24.05		

Analysis of variance :

Source of variation	Degree of freedom	Sum of squares	Mean square	Variance ratio 'F'
Levels	5	30.237	6.0474	206.8355**
Varieties	1	40.1971	40.1971	1374.84
Error	22	0.64323	0.02920	
Total	35	175.391		



Grain yield of *Oryza sativa* Linn. cv. Pusa 1509 and Pusa sharbati as affected by different levels of N fertilizer along with BGA.

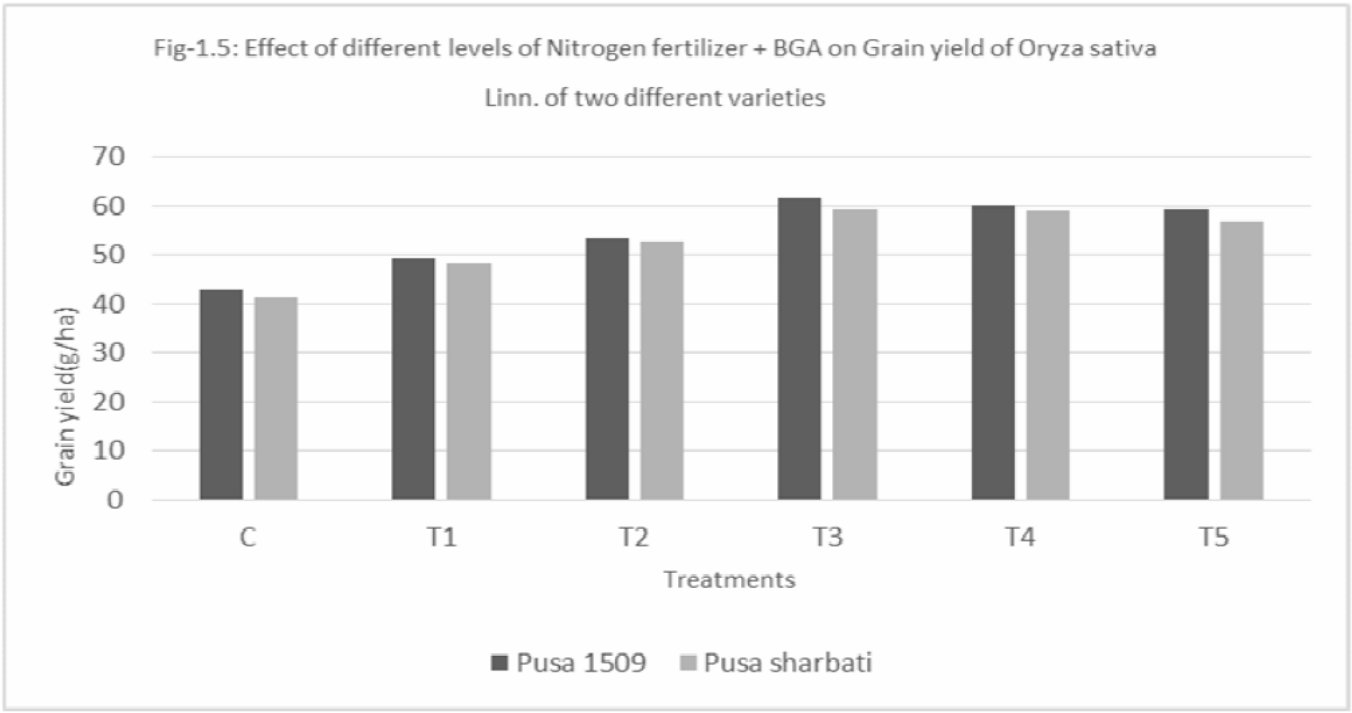
Different levels of N fertilizer along with BGA had significant bearing on grain yield of rice in both the varieties (Table 1.5 along with analysis of variances). In treatment T1 which had only 12.5 kg BGA the value 49.16 in var. Pusa 1509 and 49.39 in var. Pusa sharbati. in treatment T2 where 40 kg N/ha along with BGA is given the value of grain yield is 53.33 in Pusa 1509 and 52.86 in Pusa sharbati. however ,in treatment T3 which had double quantity of N along with BGA the value is 61.67 in var. Pusa 1509 and 59.35 in var. Pusa sharbati but in treatment T4 and T5 where 120 and 160kg N/ha along with BGA the value of grain yield is 6.004 and 59.83 in var. Pusa 1509 and Pusa sharbati.

Table 1.5 : Grain yield (q/ha) of *Oryza sativa Linn.* as affected by different levels of nitrogen fertilizer +BGA.

Nitrogen level +BGA	Varieties		Total	Mean
	Pusa 1509	Pusa sharbati		
C 0 kg ha^{-1}	42.83	41.28	84.11	42.06
T1 0 kg ha^{-1} + 12.5 kg	49.16	48.39	97.55	48.78
T2 40 kg ha^{-1} + 12.5 kg	53.33	52.86	106.19	53.10
T3 80 kg ha^{-1} + 12.5 kg	61.67	59.35	121.02	60.51
T4 120 kg ha^{-1} + 12.5 kg	60.04	58.98	119.02	59.51
T5 160 kg ha^{-1} + 12.5 kg	59.34	56.83	116.17	58.09
Total	326.37	317.69		
Mean	54.40	52.95		

Analysis of variance:

Source of variation	Degree of freedom	Sum of squares	Mean squares	Variance ratio 'F'
Levels	5	1543.63	308.727	11051.32**
Varieties	1	19.7335	19.7335	706.39
Error	22	0.61459	0.02790	
Total	35	1658.95		



Discussion

Nitrogen occupies a prime place in growth promotion in Rice. The higher N uptake and apparent N recovery in grain could be reflected in higher agronomic efficiency and ultimately the higher yield of rice. Chemical fertilizer along with blue green algae contributed to a great extent in influencing the seed yield and yield attributing parameters of rice (Bahmaniar, 2007).

Increasing rate of N along with BGA showed significant impact on yield and yield attributes. Height of plant, number of productive tillers/plant, number of spikelets/ panicle, 1000 seed weight showed an increase with increase in level of nitrogen with BGA. The cumulative effect on high doses of nitrogen on the yield attributes ultimately resulted in higher grain production.

Both the varieties responded to increasing levels of inorganic fertilizers with BGA. The lowest was control. The highest number of tillers were given by 120 kg N/ha with 12.5 kg BGA/ha followed by 160 kg N/ha with 12.5kg BGA/ha showing a clear cut effect of BGA. The varieties showed a significant difference in parameter. Satsangi *et al.* (2002) investigated that the application of BGA + urea is the best treatment for almost all growth parameter and yield attributes.

Increasing rate of N with blue green algae showed significant impact on height of plant. Plant height was higher in case of triple ro 120 kg application of nitrogen along with BGA than 40 kgN+ BGA or only BGA which significantly contributed towards higher plant height (Prasanna, R., Joshi, M.(2013).

Kotnala Savita (2003) reported that the total plant height of rice plant was found to be relatively higher when they were fertilized with BGA as compared to the plant fertilized with urea only.

Conclusion

As observed, application of blue green algae reduced the application of urea by 40% without any negotiation, and

the overall yield is noticeable increase in paddy crop. The study also revealed that 80 kg nitrogenous fertilizer combined with 12.5 kg BGA/ha is used for better growth and best result. It is also observed that BGA is highly recommended for soil health and eco- friendly fertilizer.

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