Rice Nitrogen Use Efficiency and Traits Affected by Different Nitrogen Fertilization Management

Eficiencia de uso de nitrógeno del arroz y características afectadas por la gestión de la fertilización con nitrógeno

Eficiência e características do uso de nitrogênio no arroz afetadas por diferentes manejos de fertilização com nitrogênio

Elham Modiri[1], Davood Barari Tari [2]*, Ebrahim Amiri[3], Yousef Nicknejad[2], Hormoz Fallah[2]

1Department of Agronomy, Ph.D Student, Ayatollah Amoli Branch, Islamic Azad University, Amol, Iran.
2*Department of Agrotechnology, Ayatollah Amoli Branch, Islamic Azad University, Amol, Iran. Email: d.barari@iauamol.ac.ir , davoodbarari@yahoo.com
3Department of Agriculture, Lahijan Branch, Islamic Azad University, Lahijan, Iran.
Yousef Nicknejad
2Department of Agrotechnology, Ayatollah Amoli Branch, Islamic Azad University, Amol, Iran.
2Department of Agrotechnology, Ayatollah Amoli Branch, Islamic Azad University, Amol, Iran.

Abstract
In order to evaluate nitrogen use efficiency (NUE) on rice at different nitrogen fertilization management, an experiment was carried out in field of south Caspian coastal sea, Mazandaran province, Babol, Iran (36° 29 N, 52 23 E, altitude, 23.7 m) over two cropping seasons of 2015 and 2016. An experiment was designed and laid out in factorial based on Randomized Completely Block Design with three replications. The factors were amount of nitrogen (50, 90, 130, 170 Kg N ha-1) and nitrogen splitting were at four levels (T1: 70% base + 30% maximum tillering stage; T2: 33.33% base + 33.33% maximum tillering stage + 33.33% panicle initiation; T3: 25% base + 50% maximum tillering stage + 25% panicle initiation; T4: 25% base + 25% maximum tillering stage + 50% panicle initiation). Results showed that nitrogen amount had a significant effect on aerial nitrogen, grain nitrogen, biomass in harvesting day, ANUE and PNUE at 0.01 probability level also nitrogen of above ground organ, biomass in harvesting day, NHI, ANUE and PNUE influenced significantly by nitrogen splitting. Most grain nitrogen was produced in use of 170 kg N ha-1 and T4 splitting level. In the review of an interaction effect, the interaction between Year×Splitting×Amount was significant for grain nitrogen trait at the 0.01 probability level. According to results apply 170 kg N ha-1 in way of 25% base + 25% in maximum tillering stage + 50% in panicle initiation for best attributes of this variety were recommended.
Keywords: Rice, Use Efficiency, NHI, ANUE, PNUE, Nitrogen

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Resumen

Para evaluar la eficiencia del uso de nitrógeno (NUE) en el arroz en diferentes administraciones de fertilización nitrogenada, se llevó a cabo un experimento en el mar costero del sur del Caspio, provincia de Mazandaran, Babol, Irán (36 ° 29 N, 52 23 E, altitud, 23.7 m) durante dos temporadas de cultivo de 2015 y 2016. Se diseñó y diseñó un experimento en factorial basado en Diseño de bloques completamente aleatorizado con tres repeticiones. Los factores fueron la cantidad de nitrógeno (50, 90, 130, 170 Kg N ha-1) y la división de nitrógeno en cuatro niveles (T1: 70% base + 30% etapa de macollamiento máximo; T2: 33,33% base + 33,33% macollaje máximo) etapa + iniciación panícula 33,33%; T3: base 25% + etapa de macollamiento máximo 50% + iniciación panícula 25%; T4: base 25% + etapa máxima de macollamiento 25% + iniciación panícula 50%). Los resultados mostraron que la cantidad de nitrógeno tuvo un efecto significativo sobre nitrógeno aéreo, nitrógeno de grano, biomasa en día de cosecha, ANUE y PNUE a 0.01 nivel de probabilidad también nitrógeno de órgano sobre tierra, biomasa en día de cosecha, NHI, ANUE y PNUE influenciados significativamente por la división de nitrógeno . La mayoría del nitrógeno del grano se produjo en el uso de 170 kg de N ha-1 y el nivel de división de T4. En la revisión de un efecto de interacción, la interacción entre Year × Splitting × Amount fue significativa para el rasgo de nitrógeno de grano en el nivel de probabilidad de 0.01. De acuerdo con los resultados, se recomendaron 170 kg de N ha-1 en forma de 25% de base + 25% en la etapa de macollaje máximo + 50% en la iniciación de la panícula para obtener los mejores atributos de esta variedad.

Palabras clave: Arroz, Eficiencia de uso, NHI, ANUE, PNUE, Nitrógeno

Abstrato

Com o objetivo de avaliar a eficiência do uso de nitrogênio (NUE) no arroz em diferentes manejos de adubação nitrogenada, foi realizado um experimento no campo do mar costeiro do Mar Cáspio, província de Mazandaran, Babol, Irã (36 ° 29 N, 52 23 E, altitude 23,7 m) mais de duas safras agrícolas de 2015 e 2016. Um experimento foi planejado e exposto em fatorial baseado no Randomized Completely Block Design com três repetições. Os fatores foram quantidade de nitrogênio (50, 90, 130, 170 Kg N ha-1) e nitrogênio foram divididos em quatro níveis (T1: base de 70% + 30% de perfilhamento máximo; T2: 33,33% de base + 33,33% de perfilhamento máximo). estágio + 33,33% iniciação da panícula; T3: 25% base + 50% estágio máximo de afilhamento + 25% de iniciação da panícula; T4: 25% de base + 25% de afilamento máximo + 50% de iniciação da panícula). Os resultados mostraram que a quantidade de nitrogênio teve um efeito significativo sobre nitrogênio aéreo, nitrogênio, biomassa no dia da colheita, ANUE e PNUE em nível de probabilidade 0,01 também nitrogênio do órgão acima do solo, biomassa no dia da colheita, NHI, ANUE e PNUE influenciados significativamente por nitrogênio . A maioria dos nitrogênios de grãos foi produzida em uso de 170 kg N ha-1 e nível de divisão de T4. Na revisão de um efeito de interação, a interação entre Ano × Divisão × Quantidade foi significativa para o traço de nitrogênio de grãos no nível de probabilidade de 0,01. De acordo com os resultados, aplicou-se 170 kg N ha-1 na forma de 25% de base + 25% na fase de perfilhamento máximo + 50% na iniciação da panícula para os melhores atributos dessa variedade.

Palavras-chave: Arroz, Uso Eficiente, NHI, ANUE, PNUE, Nitrogênio

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1. Introduction

Introduction
Rice is one of the most important food products in the world and known as the major staple food for about 3 billion people, equivalent to almost half of the world,s population (Mustapha, 2004). This crop has an important role in people diet due to high nutritional value and high shelf life so that it can be stored for longer than corn. Umadevi et al (2012) reported that 100 gr of milled rice contain; moisture (13.7%), protein (6.8%), fat (0.5%), fibre (0.5%), Mineral (0.9%) and carbohydrates (76.7%). There are 100 countries in the world where rice is grown, these countries produce about 715 and 480 million tonnes of paddy and milled rice respectively annually (FAO, 2013). The need for rice in developing countries is increasing, so it is important to pay attention to improving the quality and quantity of this plant. Rice is the most important crop after wheat with a cultivated area of about 600000 ha in Iran. The southern part of the Caspian Sea is known as the most important areas for the production of this plant. 70% of Iran,s rice production is dedicated to these areas (Amiri Larijani et al, 2011). One of the most important factors that can affect rice production is the management of nutrient elements. Nitrogen nutrients play a special role in the rice plant. Nitrogen is the most important and most limiting nutrient for growth and yield in all areas of rice growth (Yoshida, 1981). Nitrogen plays an important role in various plant compounds such as chlorophyll, nucleotides, proteins, alkaloids, enzymes, and hormones (Azarpour et al, 2014). Nitrogen fertilizers are widely used in rice cultivation and directly affects rice performance (Habtegebrial et al. 2013) as a result of increased tillering capacity panicle and spikelets (Sathiya and Ramesh, 2009). Nitrogen application in rice has been studied by many researchers (Yutiao et al, 2015;

1. Introducción

Introducción
El arroz es uno de los productos alimentarios más importantes del mundo y se lo conoce como el principal alimento básico para unos 3 000 millones de personas, lo que equivale a casi la mitad de la población mundial (Mustapha, 2004). Este cultivo tiene un papel importante en la dieta de las personas debido a su alto valor nutricional y su alta vida útil, por lo que puede almacenarse durante más tiempo que el maíz. Umadevi et al. (2012) informaron que contienen 100 gr de arroz molido; humedad (13.7%), proteína (6.8%), grasa (0.5%), fibra (0.5%), minerales (0.9%) e hidratos de carbono (76.7%). Hay 100 países en el mundo donde se cultiva arroz, estos países producen aproximadamente 715 y 480 millones de toneladas anuales de arroz con cáscara y arroz elaborado (FAO, 2013). La necesidad de arroz en los países en desarrollo está aumentando, por lo que es importante prestar atención a la mejora de la calidad y cantidad de esta planta. El arroz es el cultivo más importante después del trigo con un área cultivada de alrededor de 600000 ha en Irán. La parte sur del Mar Caspio se conoce como las áreas más importantes para la producción de esta planta. El 70% de la producción de arroz de Irán está dedicada a estas áreas (Amiri Larijani et al, 2011). Uno de los factores más importantes que pueden afectar la producción de arroz es el manejo de los elementos nutrientes. Los nutrientes de nitrógeno juegan un papel especial en la planta de arroz. El nitrógeno es el nutriente más importante y más limitante para el crecimiento y el rendimiento en todas las áreas del crecimiento del arroz (Yoshida, 1981). s ambientales (Jiang et al., 2005).

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Fageria, Santos and Oliveira 2013; Azarpour et al, 2014; Rahman and Singh, 2013; Mannan et al, 2012; Mida, 2010 and etc).In order to increase the efficiency of nitrogen fertilizers, farmers use it as a split. The efficiency of nitrogen for lowland rice is usually about 30% of total nitrogen consumption and the rest of 70% is lost due to environmental problems (Jiang et al. 2005). Ammonia volatilization is the major process of N losses in irrigated rice, accounting for 0.41 – 40 percent of applied N as urea in most of the Asian countries (Lin et al., 2007). It has been observed that more than 60% of applied nitrogen is lost due to the lack of harmonization between the nitrogen demand and nitrogen supply (Yadav et al, 2004). Most studies in the field of nitrogen have been focused on yield and yield components. There has been little quantitative analysis about rice nitrogen use efficiency in different nitrogen management. However, far too little attention has been paid to nitrogen management and much uncertainty still exists about the NUE effects on rice yield attributes in the north of Iran. The objectives of this research are to develop an understanding of nitrogen management on rice yield and examines the emerging role of splitting use of nitrogen in the context of NUE and yield improvement.

El nitrógeno juega un papel importante en varios compuestos de plantas como clorofila, nucleótidos, proteínas, alcaloides, enzimas y hormonas (Azarpour et al, 2014). Los fertilizantes de nitrógeno son ampliamente utilizados en el cultivo de arroz y afectan directamente el rendimiento del arroz (Habtegebrial et al., 2013) como resultado de una mayor panícula de capacidad de macollamiento y espiguillas (Sathiya y Ramesh, 2009). La aplicación de nitrógeno en el arroz ha sido estudiada por muchos investigadores (Yutiao et al, 2015; Fageria, Santos y Oliveira 2013; Azarpour et al, 2014; Rahman y Singh, 2013; Mannan et al, 2012; Mida, 2010, etc.). Para aumentar la eficiencia de los fertilizantes nitrogenados, los agricultores lo usan como una división. La eficiencia del nitrógeno para el arroz de las tierras bajas es generalmente alrededor del 30% del consumo total de nitrógeno y el resto del 70% se pierde debido a problemas ambientales (Jiang et al., 2005).Fageria, Santos y Oliveira 2013; Azarpour et al, 2014; Rahman y Singh, 2013; Mannan et al, 2012; Mida, 2010 y etc.). Para aumentar la eficiencia de los fertilizantes nitrogenados, los agricultores lo usan como una división. La eficiencia del nitrógeno para el arroz de las tierras bajas es generalmente alrededor del 30% del consumo total de nitrógeno y el resto del 70% se pierde debido a problemas ambientales (Jiang et al., 2005). La volatilización del amoniaco es el principal proceso de pérdidas de N en el arroz de riego, representando entre el 0,41 y el 40 por ciento del N aplicado como urea en la mayoría de los países asiáticos (Lin et al., 2007). Se ha observado que más del 60% del nitrógeno aplicado se pierde debido a la falta de armonización entre la demanda de nitrógeno y el suministro de nitrógeno (Yadav et al, 2004). La mayoría de los estudios en el campo del nitrógeno se

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han centrado en los componentes de rendimiento y rendimiento. Ha habido poco análisis cuantitativo sobre la eficiencia del uso del nitrógeno del arroz en diferentes tipos de manejo de nitrógeno. Sin embargo, se ha prestado muy poca atención al manejo del nitrógeno y aún existe mucha incertidumbre sobre los efectos de la NUE en los atributos de rendimiento del arroz en el norte de Irán. Los objetivos de esta investigación son desarrollar una comprensión del manejo del nitrógeno en el rendimiento de arroz y examina el papel emergente del uso de nitrógeno en el contexto de la NUE y la mejora del rendimiento.

fMaterial and Methods

In order to evaluate nitrogen use efficiency (NUE) on rice at different nitrogen fertilization management, an experiment was carried out in field of south Caspian coastal sea, Mazandaran province, Babol, Iran (36° 29' N, 52º 23' E, altitude, 23.7 m) over two cropping seasons of 2015 and 2016. This place is one of the important areas of rice production in northern Iran. The climate of the site is semi Mediterranean, characterized by a humid warm summer with low rainfall and moderate winter with high precipitation. Soil physical and chemical properties of the field were determined up to the depth of 40 cm, at an interval of 10 cm, following standard procedure (Table 1). The summary of meteorological data during the experimental period is given in table 2. An experiment was designed and laid out in factorial based on Randomized Completely Block Design with three replications. The factors were amount of nitrogen (50, 90, 130, 170 Kg N ha^{-1}) and nitrogen splitting were at four levels (T1: 70% base + 30% maximum tillering stage; T2: 33.33% base + 33.33% maximum tillering stage + 33.33% panicle initiation; T3: 25% base + 50% maximum tillering stage + 25% panicle initiation; T4: 25% base + 25% maximum tillering stage + 50% panicle initiation). One plot in each application controlled. The plot size was 12 m^2 (3m×4m). Transplanting was done on 25 May 2015 and 29 May 2016 at three plants per hill with a spacing of 25cm × 25cm. Plants harvesting was done at end of August in all years of experiment. All plots were bonded and separated by 0.5 m wide strips of bare soil to avoid lateral movement of water and nutrient among treatments. The plots were hydrologically separated by plastic.

The plastics were placed at a depth of 40 cm so that there would not be any interference with water and fertilizers on the borders. All of the morphological traits of the plant were recorded during the experiment period. For each plot during the growing season, plant samples of four hills were taken to measure the dry weight of green leaves, dead/yellow leaves, stems (including leaf sheaths) and panicles, the dry weighs were obtained after oven-drying at 80 c to constant weight, and reported here as dry biomass. A selected amount of rice was selected and then dried at 70 c for 72 hours in the oven. After measuring the dry weight, samples were grounded and N concentration was determined using the micro – Kjeldahl method, following digestion in sulfuric acid (H_2so_4)-hydrogen peroxide (H_2o_2) solution. Nitrogen efficiency is obtained according to the following relationships.

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Agronomic N use efficiency (ANUE)= (grain yield with N application – grain yield without N application) / N application

Physiological N-use efficiency (PNUE)= (grain yield with N application – grain yield without N application) / (total plant N uptake with N application – total plant N uptake without N application)

Nitrogen harvest index (NHI)= grain N uptake/total plant N uptake

In all years of the experiment, grain yield and final biomass (after drying of 70 c for 48h) were determined from 5 m2 area at maturity. In this study, all statistical tests were done by the statically analysis system (SAS, ver 8). The comparison mean of data was done using Duncan,s multiple tests at the probability level of 5%.

Table 1. Soil physical and chemical properties of the experiment.

Year	Soil texture	PH	Clay (%)	Silt (%)	Sand (%)	Exchanged K (mg kg^{-1})	Exchanged P (mg kg^{-1})	Total nitrogen	Organic C (%)
2015	Loam	6.42	22	47	31	147	21	1.63	2.1
2016	Loam	6.57	28.3	46.46	25.24	144.3	14.2	1.66	2.7

Table 2. Monthly total rainfall, temperature and sunshine hours during 2015–2016.

Year	Month	Minimum temperature	Maximum temperature	Rainfall (mm)	Sun (h)
2015	April	10.3	21.4	0.5	5.4
	May	18	26.4	0.3	7.1
	June	20.1	29.1	0.8	8.2
	July	22.4	29.4	1.5	3.2
	August	22.4	34.3	1.5	8.5
2016	April	9.5	20.5	0.4	4.7
	May	15.1	21.9	0.5	3.1
	June	20.9	28.3	1.1	5.3
	July	22.4	31.4	0.4	6.9
	August	23.3	32.7	2.1	5.8

Results and Discussion

Aerial nitrogen

Based on the analysis of aerial nitrogen data, there was a significant difference between amount and splitting of nitrogen fertilization at 1% and 5% probability levels, respectively (Table, 3). Interaction effect of amount and nitrogen splitting had a significant effect on above-ground organs nitrogen at 0.05 probability level. This study analysis results on annual data showed a significant difference in different fertilization levels. So that the highest amount of nitrogen in the aerial part was observed in use of 170 kg ha-1 nitrogen in data related to both years (Table 4, 5).

Grain nitrogen

Results showed that different amount of nitrogen fertilization had a significant effect on grain nitrogen (at 1% probability level) also grain nitrogen influenced significantly by the interaction effect of Year×Amount×splitting (Table 3). Results of mean comparison showed that grain nitrogen increased significantly with increasing nitrogen fertilizer application. This significant observed at a rate of 170 Kg ha-1 in 2015 and in terms of applied 130 and 170 kg N ha-1 in 2015. Kumar et al (2015) showed that with increasing nitrogen levels in different varieties the nitrogen content of seed would be improved so that the highest level of nitrogen increase in four cultivars of rice was observed in use of 200 kg N ha-1. In the present study, the highest nitrogen content was observed at 170 kg N ha-1 in T2 and T4 splitting treatments.

Biomass in harvesting date

Results indicated that amount of nitrogen, splitting, and interaction of

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amount and splitting had a significant effect on biomass of harvesting date according to combined analysis variance (Table 3). Highest biomass of harvest day was observed in T2 and T4 splitting treatments (Table 4, 5). In a study on the effect of nitrogen fertilizer splitting on rice in Ethiopia, a positive effect of nitrogen fertilizer splitting on the biomass of harvesting day is also mentioned that the maximum biomass of harvest day was produced in use of 0.33 of nitrogen in 25 days after transplanting + 0.66 use of nitrogen in panicle initiation stage.

Nitrogen Harvest index (NHI)

Results showed that nitrogen splitting had a significant effect on NHI at 0.05 probability level (Table 3). Results of the study by Artacho et al (2009) on the application of nitrogen in rice under Mediterranean conditions indicated that increasing the amount of nitrogen does not have a significant effect on nitrogen harvest index (NHI). However, another study in this regard showed that the amount of nitrogen translocation decreases with increasing nitrogen levels, as a result, nitrogen harvest index and nitrogen use efficiency will be reduced (Quanbao et al, 2007). The results of this study will now be compared to the finding of previous work. This research produced results which corroborate the findings of a great deal of the previous work in this field.

Agronomic N use efficiency (ANUE)

Combined analysis variance results showed that nitrogen amount, nitrogen splitting and interaction of nitro Igen amount and nitrogen splitting had a significant effect on ANUE at 0.01 probability level (Table 3).Highest ANUE was observed in apply of 130 kg N ha-1. In another study in 2015, with increasing nitrogen in all cultivars of rice (4 cultivars), the agronomic efficiency decreased in two years (Kumar et al, 2015). Tayefe et al (2011) showed that a significant difference in agronomic efficiency at the different level of nitrogen fertilization. They reported that with an increase in nitrogen levels, ANUE decreased.

Physiological N-use efficiency (PNUE)

Results indicated that nitrogen amount, nitrogen splitting and interaction of nitrogen amount and nitrogen splitting had a significant effect on PNUE at 0.01 probability level. Results of assessment of PNUE in 2015 and also 2016 showed significant differences at 0.05 probability level in different nitrogen fertilization levels. In this study, three levels of fertilization (50, 90 & 130 kg N ha-1) in 2015 showed the same effect, while in 2016 the highest efficiency was observed only in the amount of 50 kg ha-1 nitrogen fertilization. Results of this study are similar to those of Kumar et al (2015) and Tayefe et al (2011). Results presented in these reports indicate that increasing nitrogen application has an inverse relationship with the physiological efficiency of nitrogen.

Conclusion

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In this research, data from 2 years were compared then it was analyzed by the breakdown of the annual data. Results of combined analysis of crop data in 2 years showed that there was a significant difference in all levels of fertilization and in all of the evaluated factors except nitrogen harvest index (NHI). Results of Wang et al,s study on rice in China in 2014 and 2015 showed a significant effect of nitrogen fertilization levels on nitrogen harvest index (NHI). So that increase in nitrogen content resulted in a reduction of harvest index (Wang et al, 2017). In the present study, there was a significant difference (at 5% probability level) on Agronomic N use efficiency (ANUE) and biomass of harvesting date in all fertilizer treatments while aerial nitrogen, harvest index and physiological N-use efficiency (PNUE) were significant for two years at 1% probability level. In the review of an interaction effect, the interaction between Year×Splitting×Amount was significant for grain nitrogen trait at 1% probability level. The important point in this research is the ineffectiveness of the year,s factor on the indices being evaluated. It seems that the set of environmental factors including insignificant differences in soil data in 2 years, modest climatic changes, use of a constant cultivar in the experiment, use of the same technique in the planting and harvesting process could be effective reasons on this subject.

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Table 3: Compound Analysis of some Nitrogen parameters in rice Shiroudi cultivar in 2 years 2015 -2016.

S.O.V	Df	Above ground organ N	Grain Nitrogen	Biomass in Harvesting DAY	NHI	ANUE	PNUE
Year	1	331.32 ns	166.11 ns	10016000.1ns	0.0001 ns	51.98 ns	4.32 ns
Error (Year)	4	1643.74	110.16	3343691.3	0.023	693.69	24.06
Nitrogen Amount	3	17347.62 **	9717.92**	42085965.4**	0.012 ns	38147.91**	711.11**
Nitrogen Splitting	3	629.25 *	442.52 ns	5780159.0**	0.03 *	1829.31**	218.88*
Amount ×Splitting	9	131.0 *	134.37 ns	2730418.8**	0.01 ns	679.68**	47.9**
Amount ×Year	3	111.62 ns	61.64 ns	442642.3 ns	0.0079 ns	1.31 ns	22.23 ns
Year×Splitting	3	24.38 ns	91.72 ns	159896.2 ns	0.004 ns	7.52 ns	8.95 ns
Amount×Year ×Splitting	9	23.85 ns	256.49 **	173671.7 ns	0.01 ns	5.51 ns	2.76 ns
Total Error	60	189.09	75.64	969895.6	0.008	381.92	55.71
CV (%)		9.61	8.36	6.98	10.99	23.34	16.01

Biomass in harvested day. Amounts of Nitrogen: 50, 90, 130 and 170 Kg ha^{-1}. Treatments: T1: Basal 70% +Tillering stage 30%; T2: Basal 33.3% +Tillering stage 33.3% + Panicle initiation 33.3%. T3: Basal 25%+Tillering stage 50%+ Panicle initiation 25%. T4: Basal 25%+Tillering stage 25%+ Panicle initiation 50%. ns; Non-significant., * and ** respectively significant at 5% and 1%.

Table 4: Mean square of some nitrogen parameters in rice Shiroudi cultivar in 2015 .

Treatment	Kg ha^{-1}	Above ground organ N	Grain Nitrogen	Biomass in Harvesting Day	NHI	ANUE	PNUE
Amount of N Fertilizer	50	101.3 d	72.7 d	12077.7c	0.71 a	42.30 d	53.38 a
	90	135.33 c	104.81 c	13618.2 b	0.76 a	60.19 c	48.22 a
	130	146.65 b	111.9 b	14867. 0 a	0.76 a	89.11 a	49.24 a
	170	167.14 a	120.23 a	14269.4 ab	0.73 a	74.21 b	40.74 b
Treatment (Spliting of N Fertilizer)	1	135.3 a	95.23 b	13218.5 b	0.72 b	67.20 b	42.74 b
	2	131.6 b	106.31 a	14070. a	0.81 a	83.65 a	51.41 a
	3	141.56 a	99.55 b	13397.2 ab	0.71 b	84.53 a	49.17 a
	4	142.23 a	108.23 a	14146.0 a	0.77 ab	82.77 ab	48.24 ab

Means in the column with the same letter are not significant different at 5% probability level.

Table 5: Mean square of some nitrogen parameters in rice Shiroudi cultivar in 2016

Treatment	Kg ha^{-1}	Above ground organ N	Grain Nitrogen	Biomass in Harvesting Day	NHI	ANUE	PNUE
Amount of N Fertilizer	50	101.89 c	77.39 c	12342.01 c	0.75 ab	35. 38 d	55.51 a
	90	145.41 b	105.05 b	14295.69 b	0.71 b	43.38 c	46.11 bc
	130	150.19 b	117.79 a	15614.65 a	0.78 a	83.51 a	49.52 ab
	170	168.19 a	120.09 a	15166.09 a	0.71 ab	61.43 b	41.87 c
Treatment (Spliting of N Fertilizer)	1	136.38 a	103.14 a	13692.13 b	0.74 ab	67.08 b	45.06 a
	2	137. 32a	108.39 a	14613.39 a	0.78 a	86.01 a	50.74 a
	3	145.48 a	102.10 a	14209.64 ab	0.70 b	85.61 a	49.32 a
	4	146.52 a	106.69 a	14901.39 a	0.73 ab	85.06 a	48.02 a

Means in the column with the same letter are not significant different at 5% probability level.

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