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RESPONSE OF DIFFERENT GROWTH AND YIELD PARAMETERS OF FOUR BLACK RICE LINES TO RECOMMENDED DOSES OF MINERAL FERTILIZERS

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Abstract

A field experiment was carried out at Rice Research station (RRS), An-Najaf, Iraq in 2018 season to assess the response of different growth, yield parameters of four black rice lines namely (Fa.mrrs1, Fa.mrrs2, Fa.mrrs3 and Fa.mrrs4) to recommended doses of mineral fertilizers (280 kg/ha, Urea and 400 kg/ha, NP). The experiment was laid out in Randomized Block Design, with four treatments in three replications. The results revealed that the plant height (129.7 cm), Panicle length (30.67 cm), 1000 seed weight (23.03 gm), and yield (8467 kg/ha), significantly increased in the line4 (Fa.mrrs4) over other lines. It was followed by number of seed per panicle (315.6) and number of filled grain (275.61) in line2 (Fa.mrrs2).

Key words : Black rice, line, farmers, mineral fertilizers.

Introduction

Rice (*Oryza sativa*) is an important crop worldwide. The demand of rice as a food product will increase with the population growth. More than 90% of rice is grown in Asia. It provides the Asian with 30-75% of calories. Rice is a plant; which belongs to the grass family *Poaceae* (*Gramineae*). It can be grown in different types of soil, but heavy soils which have high water –holding capacity are generally more suitable than other soils. It can also adapt to acid soils of pH around 4.5-5, and alkaline soils. It is also has medium tolerance to soil salinity of about 3dS/m.

In recent years, there has been growing interest in research on Black rice. It is a type of the rice species which is glutinous, packed with high level of nutrients and mainly cultivated (Tigangam *et al.,* 2018). Several recent publications postulate that black rice, is more nutritious and tasty than other rice species. It is a source of iron, vitamin E and B as well as potassium (K), antioxidant anthocyanins, has high gluten content and is low in sugar.

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In fact, the Chinese referred to the black rice as "forbidden rice" only to be eaten by nobles. Also, in Asia, it is used as food decoration. It is also regarded as a super food that can fight cancer and prevent heart disease because it is packed with healthy fiber and plant compounds. It also promotes cell growth and division.

Iraqi researchers, at the Rice Research Station (RRS), Al-Mishkhab city, An-Najaf Province, through cooperation and coordination with the International Rice Research Institute (IRRI), as the leader of global rice program) will develop and provide training courses for breeders, agronomists, and research managers, and provide data analysis programs for researchers etc. In this way, Iraqi farmers are encouraged to grow the black rice in Iraq (Image 1). New cultivars of black rice are important to their success. RRS researchers can provide recommended cultivation programs for black rice. This is especially important where cultivation practices for black rice differ from current farmers' indigenous knowledge about rice production. This is also important to increase productivity and production of rice to meet future cereal production goals.

New challenges for rice farming are emerging in Iraq. Infertile soil and limited availability of water are critical barriers to increasing black rice production. Weeds and plant diseases continue to pose major constraints in the rice field. Also, farmers are planting local rice cultivars such as Anber33, Jasmine, Forat and Al-Mishkhab. These do not respond well to improved management practices and struggle to produce grains in order to meet local needs. To face part of the challenges and encourage the farmers to grow black rice, farmers must be educated on the advantages of improved farm management practices and increased mechanization of farming operations. Additional efforts should be made to improve the quantity and quality of black rice. The main object of the present study was to find out the impact of recommended dose fertilizer (RDF) for the study area under field conditions and to continue the research work under same conditions with other macro and micronutrient so that recommendations on fertilizer use could be made.

Materials and Methods

Seeds of four rice lines were kindly provided by Rice Research Station (RRS), Al-Mishkhab city, An-Najaf Province, 160 km south of Baghdad, Iraq. The experiment was conducted during the months of June to Nov. 2018. Rice seeds were planted on June 15 and seedlings were transplanted on July 10, 2018 at plant spacing of 30 cm. The experiment was carried out in randomized block design with four lines in three replications. Each line includes 20 plants.

Water control and weeding were done according to black rice management. Data were analyzed for the studied characteristics using the Genstat statistical program and according to the least significant difference (LSD) test at a significant level (0.05) to compare the differences between the averages.

Study site

The examination site was situated in Al-Mishkhab, Al-Najaf province, (32°02 1.7283 N, longitude: 44°192 51.02043 E). A Najaf is at the edge of the western desert in Iraq; it is dry and sweltering in summer and colder and drier in winter. A Najaf is around 53 m above ocean level and around 160 km from Baghdad. (Map1). The soil properties of study site are appeared in (Table 1).

Fertilizer application

Black rice lines were supplied with 280 kg N/ha soil as urea ($CO(NH_2)_2$) (46% N) and diammonium Phosphate (DAP) (18% N+20%P), at 400 kg NP/ha. Nitrogen was applied in two split applications as 140 kg/ha at 5 day after transplanting (DAT) with the remaining N applied at 35 DAT.

Temperature and relative humidity

Monthly average temperature of air and relative humidity (RH) from June to December, 2018, were measured using standard meteorological methods (Fig. 1).

Water management

According to Uphoff and Randriamiharisoa (2002), there is not limited recommendation of water management, so it is very important to keep soil well aerated during the rice growth period in respect to amount and time of water application, selected chemicals concentrations of irrigation water shown in (Table 2).

Results

The results depicted in Table 3 showed that the plant parameters significantly increased in all the treatments as following.

Plant height (cm)

Plant height was significantly affected by NP fertilizers. Significant and highest plant height was observed in black rice line Fa.mrrs 4 (129.7 cm), however the lowest value of plant height (118 cm) was recorded at black rice line Fa.mrrs2.

Yield attributes

The yield attributes of black rice lines such as Panicle length, 1000 seed weight, number of seed per panicle, number of filled grain, panicles/ m^2 and yield were significantly influenced by the recommended fertilizers. It was observed that black rice line Fa.mrrs4 gave the highest significant value of panicle length (30.67cm) and 1000 seeds weight (23.03 g) and yield (8467 kg/ha). The data also indicated that the number of seed per panicle (315.6) and number of filled grain (275.61) was recorded in black rice line (Fa.mrrs2). The highest value (205) of panicles/ m^2 was obtained in the black rice line3 (Fa.mrrs3).

Yield

Significant and highest grain yield value (8467kg/ha) was reported in black rice line4 (Fa.mrrs4), however black rice Fa.mrrs3 shows the lowest value of 6673kg/ha.

Discussion

This research is the first in a number of local studies, and further detailed studies under field conditions in RRS will follow. Chemical fertilizer offers nutrients which are readily soluble in soil solution and thereby instantly available to plants. The increase in plant height to

Table 1: Some of chemical and physical properties for study area (pre-planting).

Property	Unit	value
Soil pH	-	7.6
Ground water pH	-	7.1
Soil EC	dS m^{-1}	2.8
Ground water EC		4.4
Available N	ppm	32
Available K		161
Available P		11.5
Mg	mill equivalent^{-1}	8
Ca		7.4
Cl		10
Organic matter	g/kg^{-1} soil	6
Texture	g/kg^{-1} soil	Clay loam

Table 2: Selected chemicals concentrations of irrigation water used in this experiment.

Property	Unit	value
pH	-	7.6
EC	dS/m	1.5
Ca	mill equivalent.l^{-1}	6.8
Mg		1.4
Na		4.9
K		0.1

application of chemical fertilizers is probably due to enhanced availability of nutrients (Morteza *et al.,* 2011). Better growth with increasing NP indicates proper utilization of nutrients by the crop (Neeraj *et al.,* 2017). These findings are in close agreement with those of Murthy *et al*., (2015), Naseer and Bali (2007) and Manzoor *et al.,* (2006).

The increase in plant height due to enough nutrition (NP) can be explained in terms of possible increase in nutrient absorption capacity of plant as a result of better root development and increased translocation of carbohydrates from source to growing points (Singh and Agarwal, 2001). These results confirmed the finding of Bhiah and Musa, (2014) and Bhiah *et al.,* (2010) who reported that the N application improved plant height; same result was reported by Siddiqua (2016).

Yield attributes characters *viz*. panicles/ m^2, number of filled grains and unfilled grains/ panicle and 1000 - seeds weight was studied. All these parameters attained higher values with increasing NP fertilizer (Neeraj *et al.,* 2017). The highest black rice grain yield has been obtained with the application of NP fertilization. Similar results were reported by Ren *et al*., (1993), Salem (2006). Ehsanullah (2000) also reported that application of Farm Yard Manure (FYM) along with nitrogen fertilizer significantly increased number of panicles per square meter, panicle length, panicle weight, number of filled grains/panicle, and 1000-grain weight and grain yield in rice.

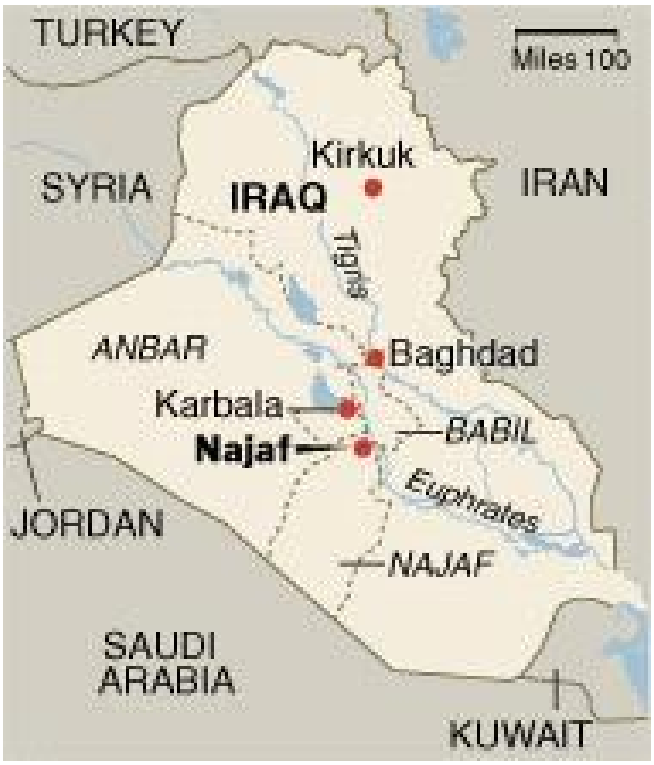
The increase in grain yield components can be due to the fact that available more water enhanced nutrient availability which improved nitrogen and other macro- and micro-elements absorption as well as enhancing the production and translocation of the dry matter content from source to sink (Ebaid *et al.,* 2007). Similar results were reported by Awad (2001) and El-Refaee *et al.* (2006). Nitrogen is an essential constituent of protein and addition of bio-organic sources might have increased nitrogen removal leading thereby to enhanced protein content in grain (Neeraj *et al.,* 2017). These results confirmed the finding of Dixit and Gupta (2000). Also our findings are also in agreement with Bhiah (2015) and Bhiah *et al*., (2015).

Tigangam *et al*., (2018) stated that the application of levels of N and P could help in avoiding the deficiencies of these nutrients by improving soil health and increasing availability of nutrient in soil by which superior grain yield attributing characters which in turn increases the number of filled grain. Phosphorus, which is limiting factor of plant growth (Safari *et al.,* 2017), positively affects tillering, root development, early flowering and accelerates the ripening of rice grains. The result also agree with Yousaf *et al.,* (2017) who reported that grain yield was significantly increased by NP, which indicate the

Table 3: Black rice growth parameter, yield and yield components under recommended doses of mineral fertilizers (RDF).

Line	Plant height (cm)	Panicle length (cm)	No. of seed per panicle	1000-grain weight (g)	No. of filled grain	No. of unfilled grain	No. of panicles per m2	Grain yield (kg/ha)
Fa.mrrs 1	129.0	29.83	267.0	19.4	251.00	18.66	156.63	7510
Fa.mrrs 2	118.0	27.67	315.6	22.0	275.61	40.00	137.33	8343
Fa.mrrs 3	124.0	26.33	162.0	21.3	142.6	22.66	205.00	6673
Fa.mrrs 4	129.7	30.67	204.0	23.03	230.60	53.66	162.00	8467
LSD 0.05	5.06	0.93	35.05	0.57	24.57	17.64	0.93	435

Image 1: Black rice.



Map1: Study location.

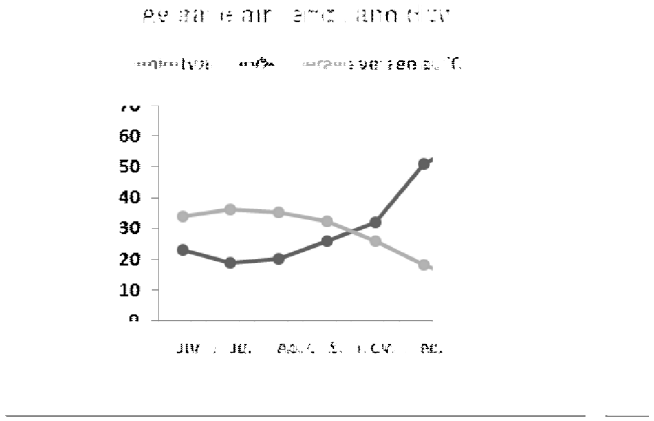


Fig. 1: Average air Temp. And humidity.

importance of N for improving crop productivity. Also same results was stated by Siddiqua (2016) and Ehsanullah (2001).

Recommendation

Expanding the study of line 4 (Fa.mrrs4) which highly response to fertilizer recommendations of Ministry of Agriculture, with addition of potassium (K) nutrient, due to its role in plant growth, activation enzymes, water uptake and photosynthesis.

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