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Effect of different doses of fertilizers on yield and yield components of medium slender grain type rice

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Abstract
Field experiment was carried out to assess the influence of various levels of NPK fertilizers (F1: 50-30-20 & F2: 100-60-40 kg/ha) on yield 5 new rice cultures namely IET 27394, IET 27438, IET 26227, IET 27117 and IET 27118 and two national checks (KRH 4 & WGL 14), in split plot design with three replications at Crop Research Station, (ANDUAT), Masodha, Ayodhya. Grain yield differences among the tested varieties were found to be significant. Significantly higher mean maximum grain yield was recorded by with IET 27118 (5.20 t/ha), at higher level of NPK 100% which was 16.33% higher at F1, followed by IET 227438 (4.75 t/ha). The increase level of NPK increases the grain yield. The highest grain yield was recorded at 100% RDF (4.72 t/ha). The lowest grain yield was recorded with 50% of RDF (3.78 t/ha). Higher nutrient response was (kg grain/kg nutrient) recorded with 100% RDF at IET 27438 (10.27) followed by IET 27394 (9.18). For good growth and yield the use of appropriate doses of fertilizers will significantly improve the yield of rice.

Keywords: Nutrient response, RDF, grain yield, NPK

Introduction

Rice (*Oryza sativa* L.) is an important cereal in the world and can be grown in different habitats as lowland, irrigated and upland rice (FAO, 2004) [2]. It originated from China and India and later spread into other parts of the continent and Africa of tropical climatic settings and is regarded as the 3th cereal after wheat and maize (FAO, 2011) [3]. Rice is cultivated for its quality grains which are rich in carbohydrate. Despite the importance of rice, the major constraints to its productivity in Cameroon are poor soil, poor cultivation methods, use of low yielding seeds, high costs of agricultural inputs, pests such as birds, insects, insufficient rice researchers and disease (Piebiep, 2008) [12]. FAO (2011) [3] reported that the annual production of rice in 2010 was 699 million tons, with Asia recording 90% production and America 5% production. Rice (*Oryza sativa* L.) is the world's most important food crop belongs to Poaceae. It serves as the staple food for more than half of the globe's population (Khan *et al*., 2013) [7]. Rice is the second most important crop which brings economic prosperity of the growers as well as earns billions of rupees through its export for country. Rice is the third highest produced cereal after wheat and maize (FAOSTAT, 2012) [4].

NPK is the key element in the production of rice and gives by far the largest response. It is the most essential element in determining the yield potential of rice and nitrogenous fertilizer is one of the major inputs to rice production (Mae T, 1997) [10]. Rice farmers in India need efficient use of fertilizers to support food security programs and increase national rice production. Efficient fertilization is obtained from balanced fertilization, namely the application of fertilizer into the soil to achieve the status of all essential nutrients balanced and optimum in the soil. Balanced fertilization can increase production, improve the quality of agricultural products, fertilizer efficiency, soil fertility, and avoid environmental pollution. The combination of fertilization greatly affects the growth of rice plants (Ramadhan F 2014) [13]. Balanced fertilization does not have to be fertilizing using all types of fertilizers. Balanced fertilization is the provision of fertilizer into the soil to achieve the status of all nutrients in the soil and the optimum growing environment for plant growth and yield. The rational needs of N, P, and K fertilizers can affect the yield components of rice. Therefore, nutrients that have reached optimum need not be added anymore. So if the land has a high P and K status, then only a low dose of P and K fertilizer is needed which is equivalent to P and K which is transported at the time of harvest. Source of nutrient can be in the form of single fertilizer, compound fertilizer or a combination of both (Kasno A, Rostaman T and Setyorini D 2016) [6].

Especially for cereal crops such as rice, corn, except NPK fertilizer, additional single Urea fertilizer is needed because N fertilizer (in this case Urea) should not be given at once but must be gradually two to three times. Giving Urea at the same time is very inefficient, most of ≥ 40 % will be lost through various mechanisms in the soil (Salikin K A 2003) [14]. (Sangeetha and Balakrishnan, 2013) reported that lower grain yield of rice obtained with absolute control which did not receive organic manures and recommended NPK addition. Nitrogen fertilization and proper time of its application is the major agronomic practice that affects the yield and quality of rice crop (Lampayan RM *et al*. 2010) [9]. Although crop production requires fertilizers, the overly large doses and use of fertilizers with chemically unbalanced NPK ratios and in intensive rice production has resulted in soil-related problems, such as acidification (Chen, J.H, 2006) loss of organic matter, deterioration of the structure, and reductions in biological activities and fertility (Zhong, W.; Cai, Z., 2007) [16]. Consequently, crop yields in several regions are stagnating or declining (Ladha, J.K *et al*., 2003) [8]. Now a days the identification and release of high yielding very early rice varieties, it becomes imperative to make a comparative assessment of the growth studies and their influence on grain yield under different nutrient combination.

Materials and Methods

The experiment were carried out at Crop Research Station, Masodha during WS 2020, which is situated at 26.47^{0}N (latitude), 82.12 ^{0}E (longitude) and at 113 m (altitude). Soil of the experimental field is sandy loam with pH 7.2, organic carbon 0.40%, Nitrogen 200 kg/ha, P2O5 24 kg/ha and K2O 234 kg/ha, to assess the influence of various level of NPK fertilizers (F1: 50-30-20 & F2: 100-60-40 kg/ha) on yield five new rice cultures namely IET 27394, IET 27438, IET 26227, IET 27117 and IET 27118 and two national checks (KRH 4 & WGL 14), in split plot design with three replications. Crop nursery was grown in raised beds and twenty one days old seedlings were transplanted in the 2nd week of July, two or three hills of seedlings were planted in each pot with planting depth and distance of 15 cm and 20 cm, respectively. Cultural practices such as weeding, irrigation, pest control etc. were done when necessary. Regular flood irrigation was applied in pots throughout the vegetative stages and left completely dried upon reaching the grain filling stages. Single fertilizer namely urea, single super phosphate (SSP) and muriate of potash (MOP) fertilizer were used as source of nitrogen, phosphorus and potassium, respectively. Split application of NPK fertilizer (Sariam, 2008) was applied based on the rice varieties growth phase, day after transplanting due to their different maturity period. Urea fertilizer was applied at split application of 50% and 50% during vegetative and heading phase, respectively.

Parameters measured for physiological characteristics of rice were: (i) grain yield t/ha, (ii) panicle no per sqm, (iii) panicle weight per panicle (g), and (vi) days to 50% flowering. Harvesting were carried out when 90% of the grains had turned hard, clear and free from greenish tint (Panda, 2010). The data on grain yield of each plot were recorded separately by threshing the harvested of rice cultures on tarpaulin followed by proper sun drying and winnowing. Data collected were statistically analysed using two-ways analysis of variance (ANOVA), and Duncan's new multiple range test (DMRT) was employed to determine the mean differences between the treatments using the statistical package.

Results and Discussion

There were significant differences among the potential medium slender grain type rice genotypes/varieties in plant growth, yield attributes and grain yield. All yield attributing characters (number of panicle/m^2 and panicle weight) were remained differed with different varieties. The data presented in table-1 and figure 1 clearly revealed that the level of NPK increase grain yield significantly. Among the treatment of 100% recommended dose of fertilizer 120:60:40 NPK, genotypes IET 27118 recorded maximum grain yield (5.20 t/ha) followed by IET 27438 (4.75 t/ha). The treatment of 50% dose of fertilizer 60:30:20 NPK IET 27118 recorded maximum grain yield (4.47 t/ha) followed by IET 26227 (3.66 t/ha). Increase the grain yield of 100% recommended dose of fertilizer IET 27438 (10.27%) followed by IET 27394 (10.27%). The lower yield t/ha was 50% RDF of IET 27394 3.48 t/ha and 100% RDF grain yield was recorded IET 27438 (3.62 t/ha).

Among the genotypes/varieties, IET 27438 (MS grain) recorded maximum number of panicles m-2 at 100% RDF (313), maximum panicle weight of 100% RDF, IET 27394 (2.11g).

Table 1: Grain yield and ancillary characters of MS rice at different levels of NPK fertilizer doses.

	Grain yield t/ha		**% increase over F1**	**Nutri. res. (kg grain/ kg Nutri.)**	**Panicle No./m^2**		**% increase over F1**	**Panicle weight (g)**		**% increase over F1**	**days to 50% flowering**		**% increase over F1**
Cultivar	**F1**	**F2**		**F2**	**F1**	**F2**		**F1**	**F2**		**F1**	**F2**	
IET 27394	3.48	4.49	29.02	9.18	284	277	-2.46	2.00	2.11	5.50	114	117	2.63
IET 27438	3.62	4.75	31.22	10.27	218	313	43.58	2.00	1.90	-5.00	112	114	1.79
IET 26227	3.66	4.53	23.77	7.91	234	256	9.40	1.66	2.10	26.51	111	113	1.80
IET 27117	3.62	4.62	27.62	9.09	230	280	21.74	2.08	1.93	-7.21	112	114	1.79
IET 27118	4.47	5.20	16.33	6.64	217	263	21.20	1.74	2.05	17.82	113	114	0.88
NC KRH 4	4.25	5.21	22.59	8.73	231	302	30.74	1.90	2.20	15.79	112	115	2.68
WGL 14	3.33	4.27	28.23	8.55	264	279	5.68	2.10	2.33	10.95	113	115	1.77
Interaction F at same V					27.83			0.13			NS		
Interaction V at same F	NS				34.51			0.18			NS		
F1	3.78				239			1.93			112		
F2	4.72			8.62	281			2.09			115		
C.D.(0.05)	0.13				29.34			0.16			2.08		
C.V. (%)	2.37				8.48			6.1			1.38		

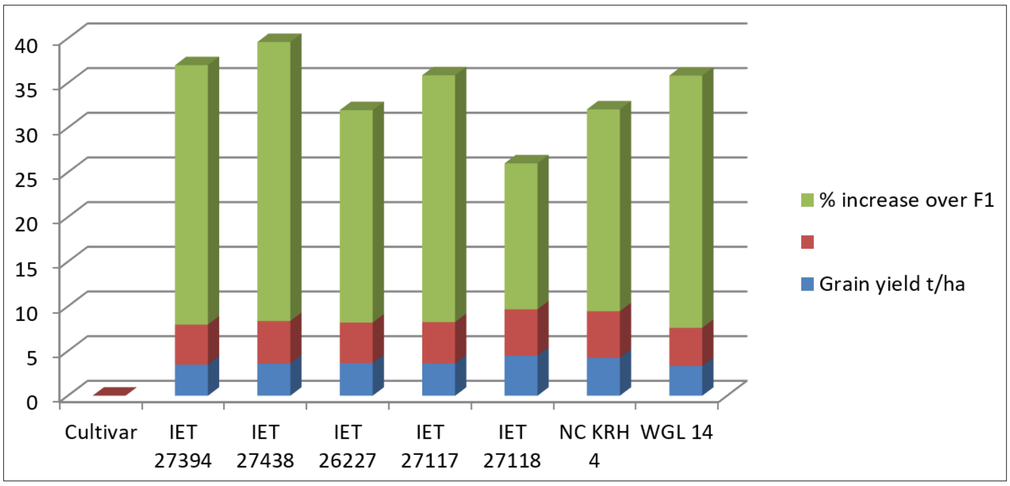

Fig 1: Grain yield and increase % over F1

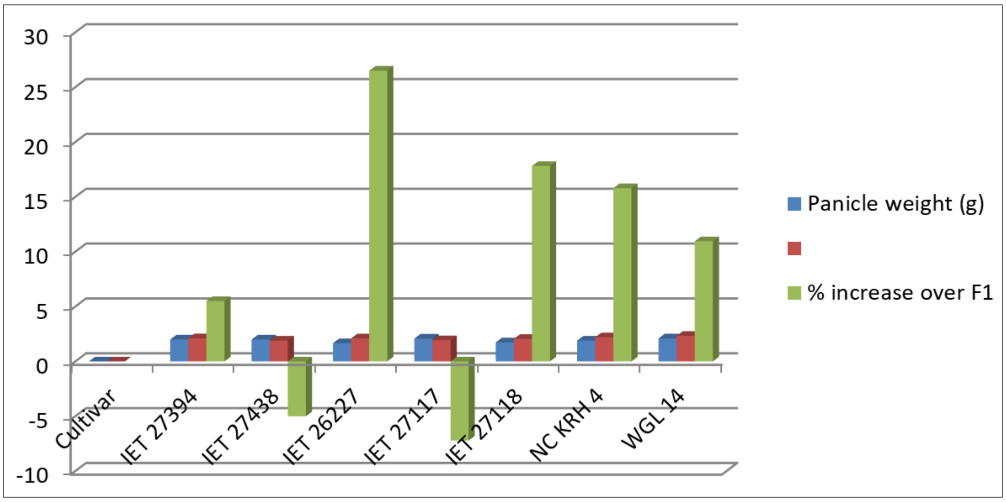

Fig 2: Panicle no. of MS rice.

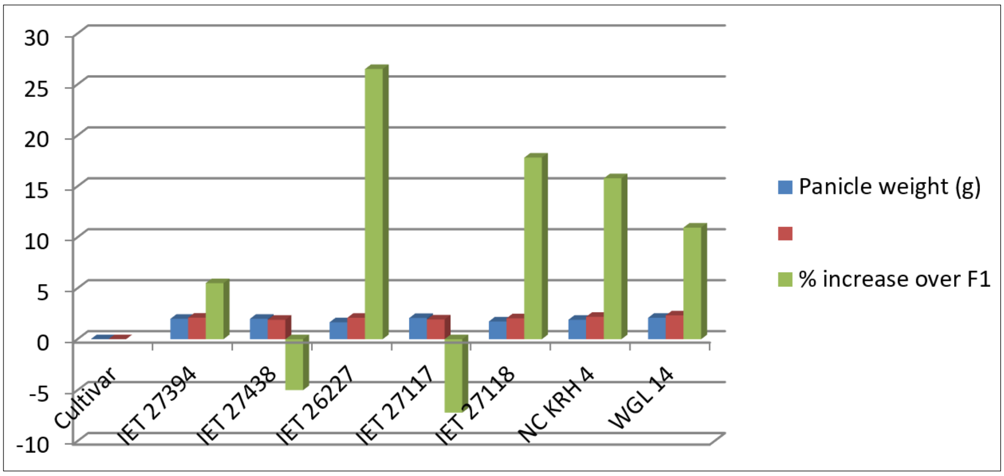

Fig 3: Panicle weight (g) of MS rice

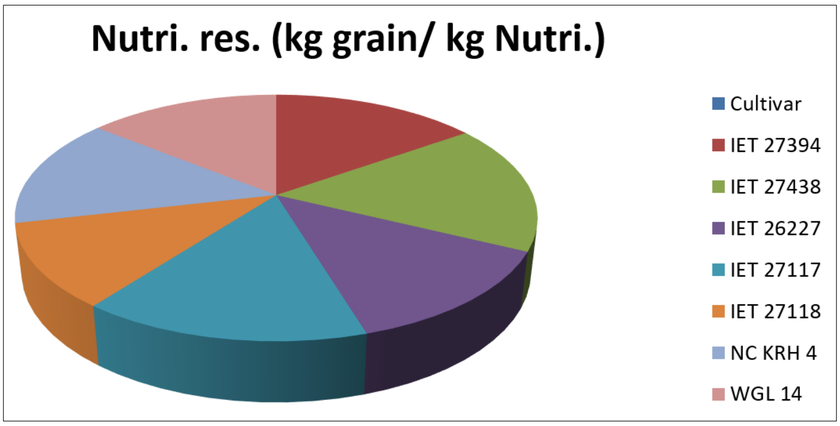

Fig 4: Nutri. res. (kg grain/ kg Nutri.) of MS rice.

From the present study, it may be concluded that among the potential medium slender grain rice genotypes/varieties IET 27118 proved most impressive by recording the highest grain yield and IET 227438 exerted second promising medium slender grain rice genotype under irrigated situation of Eastern Uttar Pradesh. IET 27118 has the potential to be an alternative/replacement as medium slender grain rice genotype for 100% recommended NPK.

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