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## **Influence of Applying Different Nitrogen Fertilizer Level on the Growth, Development and Yield of OM5451 Rice Variety in Field Condition**

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**Abstract** Applying different nitrogen fertilizer levels to evaluate their influence on the growth and development, and yield of OM5451 rice variety. The field experiments was conducted at My Chanh hamlet, My Tho city, Tien Giang province in two consecutive cropping seasons (dry and wet seasons during winter-spring 2018-2019 and autumn-summer 2019, respectively). The experiments were performed in the randomized complete block design with seven treatments and triple replications. The experiments consist of 07 levels of nitrogen (kg/ha) ranged from 60, 75, 90, 105, 120, and 135 including the control treatment. Experimental results have identified the appropriate fertilizer application for the dry season is 90 kg N and 75 kg N for the wet season for the highest average yield (5.27 and 4.67 tons/ha).

**Keywords** OM5451 rice variety, nitrogen fertilizer level, winter-spring, summer-autumn, yield

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### **Introduction**

Rice (*Oryza sativa* L.) has a vital role in food security of the world which provides the food for more than a half population of the world [1]. With high amount of rice production are frequently consumed in Asia where the natural conditions are favorable for growing rice [2-3]. Because of rapid increasing worldwide population, rice production needs to raise 1.2 – 1.5% annually without the expansion in the area of rice paddy field to secure the food security of the world [4].

In Vietnam, rice growing areas have had trend to expand from 6.8 million ha in 1995 to 7.5 million ha in 2015, and annually produced over 40 million tons. In 2018, rice export reached approximately 6.2 million tons, equivalent to US\$3.15 billion [5]. The attained achievement due to application of the advanced science and technology including introducing newly different rice varieties and efficient irrigation system and nutrient management of fertilizer that made Vietnam became the second rice exporter of the world [6].

Among numerous fertilizers, nitrogen is the most crucial nutrient which directly influences rice yield. Therefore, nitrogen management is a critical solution for improving the productivity of rice. In several reports on rice, many scientists had spent more time to find the solution for managing nitrogen rather than other nutrients because it could bring higher efficiency compared to fertilizer development [7]. Even though fertilizing high level of nitrogen can lead to the appearance of some pests and diseases, soil degradation, 60-70% of nitrogen lose through volatilization and leaching under three major nitrogen forms: NH<sub>3</sub>, NO<sub>2</sub>, N<sub>2</sub> [8-9]. Furthermore, environment pollution which caused by undissolved nitrate is a crucial environmental issue [10]. Some previous researches pointed out that nitrogen has an essential role to enhance the efficiency of fertilizer on crops. Different kinds of fertilizers can be effective when nitrogen level in fertilizer equals to the needs of crops. Thus,



fertilizers need to provide based on the enough amount of nitrogen must be applied [10]. Hence, the research on apropos nitrogen fertilizer level for rice is an important role in enhancing the effectiveness of fertilizer, improving rice yield, raising the quality of rice and brings high economic value to farmers. Therefore, the objective of the current study was to evaluate the influence of different nitrogen fertilizer level on the growth, development and yield of OM5451 rice variety in 2018-2019 winter-spring season and 2019 summer-autumn season in My Tho City, Tien Giang Province.

## Materials and Methods

### Materials

The elite OM5451 rice variety was used to evaluate the effects of different dose application on the paddy field condition. In this study the fertilizers which consist of urea fertilizer (46% N), superphosphate fertilizer (16%  $P_2O_5$ ), potassium chloride fertilizer (60%  $K_2O$ ), pesticides and other materials were applied.

### Experimental Design

The field experiments were conducted on the areas of 1000 m<sup>2</sup>. The experiment was designed by using Randomized Complete Block Design – RCBD, single factor with 7 treatments, triple replicates, area each block: 30m<sup>2</sup> as following:

- T1: Control (no fertilizer)
- T2: 60kgN/ha + 40kg $P_2O_5$ /ha + 30kg $K_2O$
- T3: 75kgN/ha + 40kg $P_2O_5$ /ha + 30kg $K_2O$
- T4: 90kgN/ha + 40kg $P_2O_5$ /ha + 30kg $K_2O$
- T5: 105kgN/ha + 40kg $P_2O_5$ /ha + 30kg $K_2O$
- T6: 120kgN/ha + 40kg $P_2O_5$ /ha + 30kg $K_2O$
- T7: 135kgN/ha + 40kg $P_2O_5$ /ha + 30kg $K_2O$

### Observation Criteria

- Yield factors: Grain/m<sup>2</sup>, filled grain/panicle, 1000 grains weight
- Total productivity: (tons/ha).

### Time and Location

- Time: Winter-Spring 2018-2019 and Summer-Autumn 2019
- Location: Tan My Chanh hamlet, My Tho city, Tien Giang province.

### Statistical Analyses

All raw data obtained were statistically analysed by Excel version 2017 and IRRISTAT 5.0 softwre.

## Results and Discussion

### Influence of nitrogen level on yield factors and productivity of OM5451 rice variety

Rice yield is a factor which demonstrates the influence result of techniques on the growth and development of rice. In this experiment, the yield is the criteria to assess the difference of experimental factors. Rice yield was conducted from various factors: panicle per square, grain per panicle, filled grains ratio and the 1000 grains weight. The yield of rice is maximum when these factors are optimized.

Among the yield factors, the number of panicles is the essential factor which contributes 74% of the productivity. Otherwise, 26% of the yield is contributed by the number of grains and 1000 grains weight. The number of panicles is regulated by three factors: Seeding density, number of tillers, other external factors: fertilizers, light cycle and intensity, temperature [11].

The results were demonstrated in Table 1 and Table 2 and shown that the increasing of fertilizing nitrogen level which led to the rising of panicle/m<sup>2</sup>. The 2018-2019 Winter-Spring season had the lowest panicle were 340 panicles/m<sup>2</sup> (control), number of panicles gradually increased in other treatments and reached the peak at 415 panicles/m<sup>2</sup> (nitrogen level: 135kgN/ha). The Summer – Autumn 2019 had similar result; the lowest panicle



observed in control block had 349 panicles/m<sup>2</sup>. The number of panicles per square meter increased accompanying with the raising of nitrogen level and hit the highest number at 90kgN/ha which was 432 panicles/m<sup>2</sup>. Resultantly, nitrogen level in Winter-Spring 2018-2019 and Summer - Autumn 2019 has an obvious impact on panicle/m<sup>2</sup> with the significantly different compared to the control.

**Table 1:** The influence of nitrogen level on yield factors and productivity of 2018-2019 winter-spring season

Treatment	Panicle/m <sup>2</sup>	Filled grain/panicle	1000 grains weight(g)	Total productivity (tons/ha)
Control (no fertilizer)	340 c	50 d	26.0	3.87 c
60kgN/ha	375 bc	64 a	26.9	4.90 ab
75kgN/ha	380 bc	65 a	26.4	5.20 a
90kgN/ha	423 a	65 a	26.8	5.27 a
105kgN/ha	397 ab	61 ab	26.4	5.13 ab
120kgN/ha	408 ab	56 bc	26.1	4.67 ab
135kgN/ha	415 ab	53 cd	26.2	4.53 bc
F	*	**	ns	**
CV <sub>%</sub>	6.0	5.4	1.6	8.1

The similar letters in a column indicated no significant differences at the  $p < 0.05$  probability level

#### Filled grain/panicle is regulated by these factors:

- Level of nitrogen: Each rice variety will have a specific limitation of nitrogen level for growing, developing and yield factors of rice. Exceeding the limitation can lead to the reduction of filled grain number.
- Light intensity: A decrease in light intensity will reduce photosynthesis activity which diminishes the formation of carbohydrates in grain also a factor lowers the filled grain per panicle.
- External factors: Temperature, drought, flood, pests, also have a negative effect on the number of filled grains.

The observation criteria results in this experiment showed that the number of filled grains gradually decreased while the nitrogen level increased but significantly higher than controls. Filled grain number fluctuated around 53-65 filled grains (2018-2019 Winter-Spring season) and 44-55 filled grains (2019 Summer-Autumn season).

**Table 2:** The influence of nitrogen level on yield factors and productivity of 2019 Summer-Autumn season

Treatment	Panicle/m <sup>2</sup>	Filled grain/panicle	1000 grains weight (g)	Total productivity (tons/ha)
Control (no fertilizer)	349 b	44 d	26.3	3.53 c
60kgN/ha	406 a	55 a	26.7	4.53 a
75kgN/ha	431 a	53 ab	26.0	4.67 a
90kgN/ha	432 a	48 cd	26.2	4.40 ab
105kgN/ha	423 a	53 abc	26.2	4.60 a
120kgN/ha	427 a	49 bc	26.1	4.28 ab
135kgN/ha	423 a	49 bc	26.3	3.99 b
F	**	*	ns	**
CV <sup>(%)</sup>	76.	8.0	3.9	5.8

The similar letters in a column indicated no significant differences at the  $p < 0.05$  probability level

The last factor related to rice yield components is the 1000 grains weight. Compared to the other factors, 1000 grains weight is a plateau which mostly depends on rice variety, farming techniques: fertilizer, soil, irrigation, weather, pests and diseases.

As shown in Table 1 and Table 2 pointed out that with the similar in rice variety, the level of nitrogen fertilizer did not cause any influence on 1000 grains weight. Rice yield is a complex factor which can represent the



growth and development of rice in the vegetative period and reproductive growth period. The result indicated the augmentation of nitrogen level led to the decline in productivity of rice but significantly higher than control. Total productivity (Table1 and Table.2) in specific treatments had different results which around 4.53-5.27 tons/ha, 3.99-4.67 tons/ha in 2018-2019 Winter-Spring season and 2019 Summer-Autumn season, respectively. In addition, the total productivity in 2018-2019 Winter-Spring season reached a peak at 5.27 tons/ha with the level of nitrogen was 90 kgN/ha, while 2019 Summer-Autumn season was about 4.67 tons/ha with 75 kgN/ha of nitrogen level. In conclusion, different levels of nitrogen have influenced on total productivity of OM5451 rice variety.

**Table 3:** The efficiency of different nitrogen level on the productivity of OM5451 rice variety in My Tho - Tien Giang

Treatment	2018-2019 Winter-Spring season		2019 Summer-Autumn season	
	Total productivity (tons/ha)	The increasing of productivity compared to control (%)	Total productivity (tons/ha)	The increasing of productivity compared to control (%)
Control (No fertilizer)	3.87 c	-	3.53 c	-
60kgN/ha	4.90 ab	26.6	4.53 a	28.3
75kgN/ha	5.20 a	34.4	4.67 a	32.3
90kgN/ha	5.27 a	36.2	4.40 ab	24.6
105kgN/ha	5.13 ab	32.6	4.60 a	30.3
120kgN/ha	4.67 ab	20.7	4.28 ab	21.2
135kgN/ha	4.53 bc	17.1	3.99 b	13.0
F	**	-	**	-
CV(%)	8.1	-	5.8	-

*The similar letters in a column indicated no significant differences at the  $p < 0.05$  probability level*

The result in assessing the efficiency of nitrogen fertilizer on rice had been illustrated in Table 3. In different treatments significantly higher than control about 0.66 – 1.40 tons/ha (17.1-36.2%) in 2018-2019 Winter-Spring season and 0.46-1.14 tons/ha (13.0-32.3%) 2019 Summer-Autumn season. Moreover, the fertilizing of nitrogen has a positive effect on rice which has been grown on alluvia soils of Tien Giang in both Winter-Spring season and Summer-Autumn season on 40kg P<sub>2</sub>O<sub>5</sub> + 30kg K<sub>2</sub>O background. In conclusion, the balance of various fertilizers is a crucial factor which regulates to the increasing of rice yield and the effectiveness of fertilizer.

### Conclusions

In conclusions, The experimental result of the influence of nitrogen level on rice in 2018-2019 Winter-Spring season and 2019 Summer-Autumn season showed: Different levels of nitrogen had an impact on panicle/m<sup>2</sup>, filled grain/panicle and total productivity in 2018-2019 Winter-Spring season and 2019 Summer-Autumn season in My Tho – Tien Giang. The optimum of nitrogen levels is 90 kgN/ha, 75 kgN/ha in Winter-Spring season and Summer-Autumn season, respectively. The Winter-Spring season and Summer-Autumn season in My Tho – Tien Giang fertilize with the following fertilizer: 90 N + 40 P<sub>2</sub>O<sub>5</sub> + 30 K<sub>2</sub>O kg/ha and 75 N + 40 P<sub>2</sub>O<sub>5</sub> + 30 K<sub>2</sub>O kg/ha, respectively which gives the highest total productivity: 5.27 tons/ha in Winter-Spring season and 4.67 tons/ha in Summer-Autumn season.

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