The effect of plant density and nitrogen fertilizer levels on yield and yield components and some physiological indices of rice cv. Hashemi in Roudsar

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Extended Abstract

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Introduction: Rice is the main staple food for more than half of the global population. According to reports, Iran has achieved 20th place in the global ranking for rice production (FAO, 2011). Rice plant require large amounts of mineral nutrients including nitrogen for their growth, development and grain production (Ma, 2004). Managing rice crop's nitrogen nutrition is difficult because lowland rice crop culture leads to nitrogen losses through ammonia volatilization, nitrification, denitrification, leaching, and runoff, which decreases the availability of nitrogen for rice plants. The density that results a maximum yield depends on temperature, solar radiation, moisture, soil fertility and other factors. Use of optimum planting density per unit area ensures plants to grow properly both in the upper ground and underground parts of the plant through better utilization of solar radiation and nutrients (Bozorgi et al., 2011). Functional leaves, dry matter production and leaf area index are the main growth factor which may directly reflect to grain yield. Growth analysis parameters like CGR are product of LAI. NAR is the net gain in total dry matter per unit leaf area per unit time.

Materials and Methods:

In order to investigate the effect of plant density and nitrogen fertilizer levels on yield and yield components of rice cv. Tarom Hashemi, an experiment was

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performed in Rudsar city (Gishakjan village), Iran in 2016 cropping season. Experimental treatments were arranged in a split-plot layout based on randomized complete blocks with three replications. The main factor consisted of four levels of plant densities including 100 plants/m^2 (10Í10 cm), 25 plants/m^2 (20Í20 cm), 16 plants/m^2 (25Í25 cm) and 11 plants/m^2 (30Í30 cm) and the sub-factor was assigned to nitrogen fertilizer (N) at four levels of 0, 40, 80 and 120 kg/ha. The nitrogen fertilizer from urea source was added to the experimental plots at different stages of rice growth with 50 % of N fertilizer applied at transplantation time, 25 % at reproductive phase and 25 % at heading time. The evaluated traits were as follows: number of panicle per plant, number of grain per panicle, grain yield, biological yield, panicle length, harvest index, LAI, CGR and NAR. To calculate the growth indices, the sampling was performed 10 days after transplantation with one-week interval until harvest stage and two hills from each plot were cut to determine some attributes such as total dry weight and the leaf area were measured.

Results and Discussion:

The results of variances analysis indicated that fertile tiller number per plant/ m^2, grain number in panicle, grain yield, biological yield and harvest index were significantly affected by plant density, nitrogen fertilizer levels and their interaction. The highest LAI and CGR were obtained from the plant density of 100 plants/m^2 (10Í10 cm). Higher N levels resulted in higher LAI and CGR as compared to lower N levels. The greatest grain yield (6833 kg/ha) was observed under plant density of 25 plants/m^2 (plant distance of 20×20 cm) and N fertilizer application of 80 kg/ha. The lowest grain yield (4780 kg/ha) was related to plant density of 11 plants/m^2 (plant distance of 30×30 cm) and no application of N fertilizer. The results showed that the application of80 kg/ha N fertilizer increased the grain yield by 43% as compared to the control plants. In spite of using more seedlings in plant density of 100 plants/m^2 (plant distance of 10×10 cm), the grain yield was reduced due to the competition between plants. According to our results, the best treatment in this study was plant density of 25 plants/m^2 and 80 kg /ha N fertilizer, which produced the highest grain yield. To further verify these results, more research works should be conducted at several locations and years.

Conclusion:

The highest grain yield and number of grain per panicle were recorded with 23 plants 25/m^2 and 80 kg/ha N fertilizer. The application of N fertilizer (80 kg/ ha) increased the grain yield by 43 % as compared to no N fertilizer treatment. This might be due to increased availability of nitrogen for the wheat plant during developmental and reproductive stages, which resulted in higher leaf area index and crop growth rate, ultimately leading to higher grain yield.

Keywords: Nitrogen, plant density, rice, yield.

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