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Investigation Chlorophyll Condition at Different Nitrogen Fertilization Methods in Rice by Applied Mathemathics Relations (*Oryza sativa*)

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Abstract: In order to investigate nitrogen condition in rice with use of chlorophyll meter, a field experiment was carried out in Amol (Iran) in factorial in basis of Randomized Completely Block Design with three replications in 2012. Factors were amount and splitting of nitrogen fertilizer. Nitrogen amount in four levels (40, 80, 120 and 160 kg N ha^{-1}) and nitrogen splitting factor in four levels (T1=50% base + 50% in tillering stage, T2= 33.33% basal + 33.33% in tillering stage + 33.33% in panicle initiation stage, T3= 25% basal+37.5 % in tillering stage + 37.5% in panicle initiation stage. T4=25% in basal +33.33% tillering +33.33% panicle initiation). Results showed that, there are significant differences in SPAD values between nitrogen fertilization, increases in rice yield obtained in treatments T_2 and T_4 were similar and had significant differences with control. The SPAD reading at all stages was positively correlated with rice yield that illustrated the importance of chlorophyll content and its related to grain yield.

Key words: Rice · Chlorophyll · Nitrogen · Yield

INTRODUCTION

Unsustainably in rice yields in world maybe attributed to indiscriminate use of chemical fertilizers particulary nitrogen. This increased use of N fertilizers increased the pest and diseases there by increasing the use of plant protection [1, 2]. There is need to develop and evaluate suitable technique to obtain higher grain yield and profit without any deficiency. Balasubramanian *et al*. [3] and Bijay *et al*. [4] suggested that, chlorophyll meter (SPAD) as important tools to diagnose the nitrogen status in rice to decide time of N top dressing. Innovative tools such as the chlorophyll or SPAD meter offer a new strategy for obtimizing fertilizer nitrogen (N) application in rice [5, 6]. A simple and portable device, the SPAD meter provides a nondestructive and accurate measurement of rice leaf status in situation in the field. Earlier studies indicated the critical SPAD values could be established for different varieties and growing seasons. Depending on local growing conditions [7]. For achieving high yields of rice, farmers in many parts of the world tend to apply N in excess of requirements. The chlorophyll meter also know as SPAD (Soil Plant Analysis Development). Can quickly and reliably assess the N status of a crop based on leaf area. It has been successfully used for rice. The rice plant at any point in time is composed of leaves of physiologically different ages [8]. The correlation between leaf area and yield [9] suggests that chlorophyll and leaf area are important in determining the yield [10]. The chlorophyll content in leaf tissues varies with the age of plant [11] the species and the growing season. The role of chlorophyll in photosynthesis content and rate of hotosynthesis is equivocal [12]. The chlorophyll meter or SPAD is a simple, quick and nondestructive method for estimating N of rice leaves, very limited research works are available so far to establish SPAD for rice in world. Use SPAD for following objectives:

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- To save N without decreasing yield of rice
- To avoid expenditure on soil test for the recommendation of N fertilizer.
- To find out the relative efficiency of SPAD for the N economy as well as increasing yield

MATERIALS AND METHODS

In order to investigate nitrogen condition in rice with use of chlorophyll meter, a field experiment was carried out in Amol (Iran). Experiment was laid out in factorial in basis of Randomized Completely Block Design with three replications in 2012. The Shirodi variety was used in this design. Factors were amount and splitting of nitrogen fertilizer. Nitrogen amount in four levels (40, 80, 120 and 160 kg N ha^{-1}) and nitrogen splitting factor in four levels (T1=50% base + 50% in tillering stage, T2= 33.33% basal + 33.33% in tillering stage + 33.33% in panicle initiation stage, T3= 25% basal+37.5 % in tillering stage + 37.5% in panicle initiation stage. T4=25% in basal +33.33% tillering +33.33% panicle initiation) Recommended doses of phosphorus (70 kg ha^{-1}) and potassium (60 kg ha^{-1}) were applied to all plots. The chlorophyll meter (SPAD-502, Minolta Camera Co. Ltd.Osaka, Japan) was used to record the chlorophyll content (SPAD value). A fully matured leaf from the top of the plant was selected for recording of the SPAD values and the mean of five reading per plant was taken at 13, 35, 60 and 80 DAT. Five plants were selected at Random for Mean SPAD value per treatment. Standard practices were done until crop was matured. Statical test was done by statistically Analysis System (SAS).

RESULTS AND DISCUSSION

The Spread quantity and grain yield of rice are presented in Table 2. There are significant differences in SPAD values between nitrogen fertilization treatments. These might have been caused by decreased of nutrient (N) by fertilization method and reduction in chlorophyll content. The chlorophyll meter uantifies the green colour of the plant immediately [13] and can potentially provide an estimate of the N status of rice crops [14, 15]. T_3 treatment might have improved the N status of soil. There were differences between treatments and weeks of observation. These differences might be due to the environmental parameters and variety traits influencing nutrient condition in the soil. It has been showed that chlorophyll content in leaf tissue differ with age of the plant [15] species and growing season [16]. The increases in rice yield obtained in treatments T_2 and T_4 were similar. Organic waste improved the productivity of the soil through the supply of nutrients on decomposition and this increases yield. Increased productivity is not only due to the affect on better utilization of N applied through inorganic sources but also an account of improved micro-environmental conditions. This is similar with the views of [16]. The SPAD reading at all stages was positively correlated with rice yield. The SPAD value 60 DAT was highly correlated with rice yield (r=0.96). Positive correlation between specific leaf weight and chlorophyll content in rice were produced at 7 days before flowering (r=0.8910, p<0.01), 7 before flowering (r=0.92, p<0.01) and 20 days after flowering (r=0.828, p<0.05) as reported by Sarkar results in rice [12]. The increased chlorophyll content is corrected with increased rice yield. The following and multiple regression models were devised for yield and SPAD values:

$Y_1 = -907.99 + 39.68\, x_1$ (r^2=0.8052)

$Y_1 = -1183.15 - 6.8454x_1 + 52.1797x_2$ (r^2=0.9739)

$Y_1 = -1160.75 - 9.0165x_1 + 50.9791\, x_2$ (r^2=0.9745)

$Y_1 = -1270.41 - 0.0432x_1 + 56.9378x_2 + 6.318\, x_3 - 15.0523\, x_4$ (r^2=0.9801)

$Y_1 = -1183.15 - 6.8454x_1 + 52.1797x_2$ (r^2=0.9739)

$Y_1 = -1214.26 - 22.0372\, x_1 + 51.1688\, x_2 + 24.8593\, x_3 - 22.397\, x_4$ (r^2=0.9883)

Table 1: Chlorophyll dynamics and grain yield of rice

Treatment	13 (DAT)	35 (DAT)	60 (DAT)	80 (DAT)	Grain yield
T_1	27.39b	28 d	25.85b	26.42b	6103c
T_2	35.14a	35.71ab	35.43a	37.52a	6641b
T_3	33.15a	32.53c	33.35a	35.43a	6826a
T_4	33.68a	34.79abc	34.89a	34.71a	6683a
S.E.D	1.874	1.11	1.39	1.23	314.43

Means followed by the same letter are not significantly different at 5% level by DMRT

Table 2: Correlation matrix between rice yield and SPAD values

Parameter	Y_1	X_1	X_2	X_3	X_4
Y_1	1				
X_1	0.83**	1			
X_2	0.96**	0.92	1		
X_3	0.96**	0.96	0.86	1	
X_4	0.86**	0.91	0.93	0.95	1

y= rice grain yield (g m^{-2}) and x_1, x_2, x_3 and x_4 are the SPAD readings at 13, 35, 60 and 80 DAT respectively.

*, **: significance at 5% and 1% probability level respectively.

where Y_1= rice grain yield g m^{-2} and x_1, x_2,x_3 and x_4 are the SPAD reading at 13, 35, 60 and 80 DAT, conciding with panicle in flowering is obvious. This suggests that the maintenance of optimum chlorophyll content could lead to optimum yield. Through maintenance of optimum N levels is soil during these periods. Thus this research illustrated the importance of chlorophyll content and its related to grain yield.

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