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Grain yield of aerobic ice (*Oryza sativa*) and path coefficient analysis with its attributing components under varying irrigation regimes and nitrogen levels

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Abstract
A field experiment was conducted on aerobic rice (*Oryza sativa)* during summer seasons of 2013 and 2014 at Regional Research and Technology Transfer Station, Chiplima, Sambalpur, Odisha in order to determine grain yield of aerobic rice (*Oryza sativa*) and path coefficient analysis with its attributing components under varying irrigation regimes and nitrogen levels. The results revealed that aerobic rice needs to be irrigated at 5 days interval with the application of nitrogen at 80 kg ha^{-1} produced economically higher productivity (3.22t ha^{-1})in western region of Odisha. It was concluded that significantly higher positive correlations (>0.931)between grain yield and its attributes as wellas among different attributes at 1% level of significance. The regression coefficients of all the equations are negative that indicates that for all the equations there exists a maximum value for the yield.

Keywords: Aerobic rice, irrigation regimes, nitrogen, field water use efficiency, b:c ratio

Introduction
Rice (*Oryza sativa* L.) is the staple and plays a important role in our national food security. Recently, there is an increasing scarcity of fresh water for agriculture particularly for rice cultivation due to decline in water levels which threatens the sustainability of the irrigated rice ecosystem. The traditional rice production system not only leads to wastage of water but also causes environmental degradation and reduces the fertilizer use efficiency. Hence, shifting gradually from traditional rice system to aerobic rice system can mitigate the occurrence of water related problems. Aerobic rice culture is an emerging technology and revolutionary way of growing rice where the direct-seeded rice varieties with aerobic environment are grown in well-drained, un-puddled and non saturated soils (aerobic soils). Irrigation management plays vital role in increasing the productivity of rice through efficiently and productivity of water. Nitrogen fertilizer is a key input for rice production. It is one of the most important nutritional elements for the higher productivity of cereal crops and a major factor that limits agricultural yields. The correlation and regression studies required to measure the degree of linear association between two variables and also functional relationship between a dependent variable and one or more independent variables. In this back drop, the present study was undertaken to find out proper irrigation schedule and nitrogen dose under aerobic condition in west central table land zone of Odisha.

Materials and Methods
The field experiment was carried out in the Regional Research and Technology Transfer Station, situated at Chiplima, Sambalpur, Odisha in summer season during 2013 and 2014 to investigate grain yield of aerobic rice (*oryza sativa*) and path coefficient analysis with its attributing components under varying irrigation regimes and nitrogen levels. The experiment was laid out in a split plot design with 3 replications. The treatments consisted of four irrigation regimes (irrigation at 3, 5, 7 and 9 day interval) in the main-plots and four levels of nitrogen (0, 40, 60 and 80 kg ha^{-1}) in the sub-plots. The plot of size 30 m^2 (6 m × 5 m) was used for the experiment. Seeds of (cv: APO) was manually sown @ 45kg ha^{-1} in furrows at 20 cm row spacing. The required cultural practices and plant protection measures were followed as per recommended package. Ten numbers of sample panicles were selected randomly from each net plot area just before harvesting for taking observations on yield attributes. The grain yield (t ha^{-1}) was recorded on the net plot basis. Correlation and regression studies were taken up between grain yield and other yield attributing parameters that may contribute to ultimate yield.

The methods were used to analyze the correlation and regression studies discussed below:

Correlation studies

The simple linear correlation analysis is applied to measure the degree of linear association between two variables. The correlation coefficient (r) is computed using the observed values of two variables as:

$$r = \frac{\sum_{i=1}^{n}(x_i - \bar{x}) \times (y_i - \bar{y})}{\sqrt{\sum_{i=1}^{n}(x_i - \bar{x})^2}\sqrt{\sum_{i=1}^{n}(y_i - \bar{y})^2}}$$

Where, x_i and y_i are the 'i'th value of the observed variables 'x' and 'y' respectively, $\bar{x}$ and $\bar{y}$ are the mean of the observed variables 'x' and 'y' respectively, and n is the number of observations.

The value of 'r' lies within the range of -1 to +1. A positive value of r indicates that two variables change in the same direction i.e., increase in one variable effects in increase in the other and vice-versa. A negative value of 'r' indicates that two variables change in the opposite direction i.e., increase in one variable effects in decrease in the other and vice-versa. Whereas, zero value of 'r' indicates that there is no correlation between two variables.

The two variables can be said to be correlated (either positively or negatively) when the correlation coefficient 'r' is significantly different from zero at some desired level of significance. To test the significance of the correlation coefficient, the computed absolute value of' r' is compared with the tabular value ($r_{\alpha,k}$) at the desired level of significance α with $k = n - 2$ degrees of freedom. If $r > r_{\alpha,n-2}$ then r is said to be significantly different from zero at α level of significance. Usually the table values at 5% and 1% (at α = 0.05 and 0.01) levels of significance are used for the comparison. If $r > r_{0.01,\ n-2}$ then r is said to be significantly different from zero, and if $r > r_{0.05,\ n-2}$then it is highly significantly different from zero.

Regression studies

The regression analysis deals with functional relationship between a dependent variable and one or more independent variables. The dependent variable can have one of many types of functional relationship with the independent variable(s). In this study it is assumed that yield is related to other yield attributing variables quadratic function or second degree polynomial.

The second degree polynomial function model is given by

$$y = ax^2 + bx + c$$

Where, y and x are dependent and independent variables, respectively and a, b and c are model parameters.

If the model is fits well, then the unknown y value can be estimated for any unknown value of x using the model parameters a, b and c. To use the model parameters need to be estimated before using the known or experimental values of the dependent and independent variables. To estimate the model parameters least square method has been employed. To test the goodness of fit for the model, coefficient of determination (R^2) has been used.

Differentiating y with respect to *x*

$$dy/dx = 2ax + b$$

Equating dy/dx to zero, the value of x can be obtained as: $x = -b/2a$

That means either a maximum or minimum value of y can be obtained at $x = -b/2a$

Differentiating dy/dx with respect to x

$d^2y/dx^2 = 2a$

If 'a' is negative then value of 'y' at x = $-b/2a$ is maximum. If 'a' is positive the value of 'y' at x = $-b/2a$ is minimum. So from the sign of 'a' itself, it can be known whether the function would a maximum or minimum value for the dependent variable.

The maximum or minimum value for the dependent variable can be obtained by

$$y_{max/min} = a(-b/2a)^2 + b(-b/2a) + c = -b^2/4a + c$$

Correlation and regression studies were taken up between grain yield and other yield attributing parameters that may contribute to ultimate yield. The analysis the recorded data for various parameters were carried out using the procedures described by Gomez and Gomez (1984) [1].

Table 1: Effect of irrigation regimes and nitrogen levels on yield and its attributing parameters of aerobic rice (pooled mean)

Treatments	DMA in shoot at harvest (g m^{-2})	CGR (gm^{-2}day^{-1}) at 90 DAS to harvest	LAI at 75 DAS	Effective panicles m^{-2}	Spikelets Panicle^{-1}	Filled grains Panicle^{-1}	1000 grain weight (g)	Grain Yield (t ha^{-1})
Irrigation interval(days)								
3	646.5	7.87	2.71	315.4	89.4	82.8	20.6	3.44
5	600.7	7.03	2.50	291.9	86.0	78.0	20.2	3.21
7	463.7	4.44	2.2	239.3	81.7	64.2	19.5	2.65
9	389.0	2.98	1.9	210.2	76.5	53.7	18.8	2.06
SEm ±	7.8	0.03	0.04	5.6	1.4	1.0	0.2	0.07
CD(P=(0.05)	24.1	0.10	0.09	17.2	4.2	3.3	0.7	0.23
Nitrogen levels(kg ha^{-1})								
0	423.1	4.02	1.9	218.7	74.3	57.2	18.2	1.91
40	500.0	5.33	2.1	253.5	81.8	66.6	19.5	2.69
60	566.8	6.31	2.5	278.5	86.0	73.4	20.5	3.16
80	610.8	6.67	2.78	306.2	91.5	81.5	20.9	3.58
SEm ±	8.0	0.04	0.03	4.8	0.9	0.9	0.2	0.06
CD (P = 0.05)	22.9	0.12	0.08	13.0	2.6	2.5	0.6	0.17
DMA-Drymatter accumulation CGR-Crop growth rate LAI-Leaf area index								

Results and Discussion
Yield attribute
Data on attributes given in Table 1 revealed that the higher dry matter accumulation in shoot m^{-2} (646.5g), crop growth rate at 90 DAS (7.87 g m^{-2} day^{-1}) and leaf area index at 75 DAS (2.71), effective tillers m^{-2}(315.4), spikelets $panicle^{-1}$ (89.4), filled grains panicle (82.8) and 1000grain weight (20.6)were recorded with irrigation regime at 3 days interval. It was significantly superior to rest other irrigation intervals except spikelets $panicle^{-1}$ and 1000 grain weight. The values of spikelets $panicle^{-1}$ and 1000 grain weight with irrigation at 5 day interval were statistically at par with 3 days interval and significantly superior to all other higher irrigation intervals. The increase in yield attributes under shorter irrigation intervals could be due to effective uptake of nutrients and water resulting in increase in cell elongation, more number of leaf and higher leaf area coupled with more number of tillers and seed setting rate. These results were in conformity with findings of Shekara *et al*. (2010) [4] and Maheswari *et al*. (2008) [2].

As regards to nitrogen levels, the results showed that (Table-1) dry matter accumulation in shoot /m^2 at harvest (610.83 g), crop growth rate at 90 DAS (6.67 g/m^2/day), leaf area index at 75 DAS (2.79), effective tillers m^{-2}(306.2), spikelets $panicle^{-1}$ (91.5) and filled grains panicle(81.5) increased significantly at each successive increment of nitrogen up to the highest level of 80 kg/ ha. But 1000 grain weight increased significantly with each successive increase in the levels of nitrogen up to 60kg ha^{-1} and thereafter, the increase was not significant. The increase in yield attributes with increase in nitrogen levels might be due to uptake of more nitrogen resulting in increase the cell division, cell elongation, number of leaf and leaf development coupled with more number of tillers and also accumulate more photosynthate due to better interception of photo synthetically active radiation. and translocation from vegetative parts to reproductive parts resulting in increased yield attributes. These results are also agreement with Uddin *et al*. (2013) [5] and Pradhan *et al*. (2014) [3].

Grain yield
Grain yield of rice increased significantly with decrease in irrigation interval up to 5 day and further decrease in irrigation interval did not prove beneficial during under study (Table 1). The higher grain yield of 3.42 t ha^{-1} was produced with irrigation regime at 3 days interval. The increase in grain yield owing to irrigation at 3 day interval over 5, 7 and 9 day interval were 6.1, 22.5 and 39.8%, respectively. It might be due to reduced growth of plants, more number of emerged weeds and also the water stress suffered by the plants during reproductive phase that hampered the supply of photosynthates resulting in poor yield attributes. This was in harmony with findings of Maheswari *et al*. (2008) [2] and Shekara *et al*. (2010) [4].

The grain yield of rice increased significantly with increase in nitrogen levels during under study**.** Nitrogen 80 $kgha^{-1}$ produced higher grain yield of 3.58 t ha^{-1}. The increase in grain yield owing to 80 kg Nha^{-1} over 60, 40 and 0 kg ha^{-1} were 11.7, 24.9 and 46.6%, respectively. The probable reasons assigned at 80kg ha^{-1} produced significantly higher grain yield due to enhanced stature of growth and yield attribute, forming larger sink size coupled with efficient translocation of photosynthates from source, which would have resulted in more number of filled grain there by finally reduced by grain yields. This was in accordance with the findings of Pradhan *et al*. (2014) [3] and Uddin *et al*. (2013) [5]. The interaction between different irrigation regimes and nitrogen levels on grain yield was found to be significant (Table 3).

Table 2: Interaction effect of irrigation regimes and nitrogen levels on grain yield (t ha-1) of aerobic rice(pooled mean)

Irrigation intervals(days)	**Nitrogen levels (kg ha^{-1})**			
	0	**40**	**60**	**80**
3	2.30	3.35	3.72	4.39
5	2.03	2.94	3.64	4.23
7	1.78	2.50	3.04	3.27
9	1.58	1.96	2.24	2.44
	I within N		N within I	
SEm (±)	0.12		0.08	
CD (P = 0.05)	0.36		0.24	

The interaction of irrigation at 3 day interval with 80 kgN ha^{-1} gave the higher grain yield (Table 2)which was at par with 5 day interval with 80 kgN ha^{-1} and significantly superior to other interaction of irrigation intervals with nitrogen levels.

Correlation and regression studies
Correlations Coefficient: Knowledge of the relationship among plant characters is useful while selecting traits for yield improvement. To find out the relationship between grain yield and various yield attributes, correlations were worked out and correlation coefficients (r) are given in table 3.

Correlation coefficients between grain yield and various yield attributes *viz*., number of effective panicle m^{-2}, panicle length, number of spikelets $panicle^{-1}$, number of filled grains $panicle^{-1}$ and test weight were positively and significantly different from zero at 1% level of significance. The results also showed that significantly positive correlations were among different attributes at 1% level of significance. The highest positive correlation were observed between grain yield and panicle length (0.991) and between number of effective panicle m^{-2} and number of filled grains $panicle^{-1}$ (0.991) whereas, lowest positive correlation were observed between number of effective panicle $m^{-2}$and test weight (0.931) and between number of filled grains $panicle^{-1}$ and test weight (0.931).

Table 3: Simple correlation coefficient for grain yield and its attributing characters

Characters	Yield (t ha^{-1})	Effective panicles m^{-2} (Nos.)	Panicle Length (cm)	Spikelets panicle^{-1} (Nos.)	Filled grains panicle^{-1} (Nos.)	Test weight (g)
Yield	1.000	0.971**	0.991**	0.976**	0.975**	0.982**
Effective panicles m^{-2}		1.000	0.967**	0.943**	0.991**	0.931**
Panicle length			1.000	0.960**	0.968**	0.958**
Spikelets panicle^{-1}				1.000	0.951**	0.962**
Filled grains panicle^{-1}					1.000	0.931**
Test weight						1.000

**Correlation is significant at 1% level of significance

Regression Coefficient

Regression analysis was carried out using second degree polynomial model to determine the response levels of ancillary characters *viz.* dry matter accumulation at harvest (DMA), leaf area index (LAI) at 75 DAS, number of effective panicle m^{-2} (EP) and total nitrogen uptake (NU) on grain yield (Y). The best fit regression equations are presented in table 4.

Table 4: Regression equations between ancillary characters and grain yield

Ancillary characters	Equations	R^2 value	Ancillary characters	Grain yield (t ha^{-1})
			Maximum value	
Dry matter accumulation at harvest (DMA) g m^{-2}	Y= -7.972 x 10 $^{-6}$ DMA^2 +1.454 x10^{-3} DMA-2.536	0.928	912.00	4.10
Leaf area index (LAI) at 75 DAS	Y= -7.451 x 10 $^{-5}$ LAI^2 +5.202 x 10^{-3} LAI-5.155	0.983	3.49	3.92
Number of effective panicles m^{-2} at harvest (EP)	Y= -5.993 x 10 $^{-5}$ EP^2 +4.665x 10^{-3} EP-5.219	0.955	389.00	3.85
Total nitrogen uptake (NU) kg ha^{-1}	Y= -4.784 x 10^{-4} NU^2 +7.866 x 10^2 NU + 0.592	0.998	82.42	3.84

The results (Table 4) showed that the coefficients of determination for all the regression equations are very high (more than 0.9) indicating very good agreement between the observed yield and the yield estimated using these equations. Hence, these equations can satisfactorily be used to estimate the yield for different value of independent characters.

The coefficients of all the equations are negative. This indicates that for all the equations there exists a maximum value for the yield. The value of character at which the yield would be maximum and the corresponding maximum yield are sown for each equation, in respective columns in the table 4.The value for DMA can be interpreted as: if the DMA is varied, keeping all the characters fixed, the yield will vary as per the corresponding quadratic equation. Maximum yield of 4.0 t ha^{-1} can be obtained when the DMA is 912 g m^{-2}. However, grain yield will be reduced if the DMA goes beyond 912 g m^{-2}.

Conclusion

It was concluded that significantly higher positive correlations between grain yield and its attributes as wellas among different attributes at 1% level of significance. The aerobic rice needs to be irrigated at 5 days interval with the application of nitrogen at 80 kg ha^{-1} produced economically higher productivity (3.22t ha^{-1}) in western region of Odisha.

References

1. Gomez AK, Gomez AA. Statistical procedures for agricultural research (2nd Ed.). John Wiley & Sons, 1984.
2. Maheswari J, Bose J, Sangeetha SP, Sanjutha S, Sathyapriya R. Irrigation regimes and N levels influence chlorophyll, leaf area index, proline and soluble protein content of aerobic rice. International Journal of Agricultural Research. 2008; 3(4):307-09.
3. Pradhan A, Thakur A, Sonboir HL. Response of rice varieties to different levels of nitrogen under rainfed aerobic system. Indian Journal of Agronomy. 2014; 59:76-79.
4. Shekara BG, Sharnappa, Krishnamurty N. Effect of irrigation schedules on growth and yield of aerobic rice (*Oryzasativa*) under varied levels of farmyard manure in Cauvery command area. Indian Journal of Agronomy. 2010; 55(1):35-39.
5. Uddin S, Sarkar MAR, Rahman MM. Effect of nitrogen and potassium on yield of dry direct seeded rice in aus season. International Journal of Agronomy and Plant production. 2013; 4(1):69-75.