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PRODUCTION FUNCTION OF IRRIGATION WATER AND NITROGEN FERTILIZER FOR FINGER MILLET

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ABSTRACT

An experiment was conducted at Tamil Nadu Agricultural University, Coimbatore during *Rabi* 1985-1986 and *Kharif*, 1986 with five irrigation treatments and six N levels. Of the production models viz., square root, three halves, quadratic and Cobb-Douglas tried, it was found that quadratic model gave the best fit, indicating that finger millet (CO 11) required optimum quantities of water and N for increased grain yield.

KEYWORDS: Fingermillet, Production Function, Water, Nitrogen.

Irrigation water is scarce and expensive which calls for efficient utilization of available water resources to the maximum possible advantage for crop production. Nitrogenous (N) fertilizers have contributed significantly to increased grain yield of finger millet but N dose differs with the water resource and availability. Knowledge of the production function for water and N is essential to determine the yield maximising and optimising levels of water and N for finger millet. The complex of yield responses to irrigation water and N applied can be known from production functions.

MATERIALS AND METHODS

Field experiments were conducted at the Tamil Nadu Agricultural University, Coimbatore during *Rabi* 1985-1986 and *Kharif* 1986 to determine the best suited production function model for improving water and fertilizer management and planning future research in water and fertilizer use in finger millet production. The crop growth was divided into three stages viz. transplanting to panicle initiation (PI) (Stage 1), PI to flowering (Stage 2) and flowering to maturity (Stage 3). There were five irrigation levels viz., irrigation at IW/CPE ratio of 0.6 throughout the crop period, irrigation at IW/CPE ratios of 0.3, 0.6 and 0.6, irrigation at IW/CPE ratios of 0.3, 0.6 and 0.9, irrigation at IW/CPE of 0.3, 0.9 and 0.6 during Stage 1, 2 and 3 respectively and six N levels as 0,40, 80, 120,160 and 200 kg ha^{-1}. A common dose of 45 kg.ha^{-1} each of P_2O_5 and K_2O were applied uniformly to all the plots. The experiment was laid out in a split plot design with irrigation levels alloted to main plots and N levels to sub-plots with three replications.

The experimental data obtained during *rabi* and *kharif* seasons were utilised in the study. The production function models viz. square root, three halves, quadratic and Cobb-Douglas were fitted to the data as suggested by Hexem and Heady (1978) using least square multiple regression analysis. The equations are given below.

1. $Y = a+b_1 x_1 +b_2x_2+b_3 \quad x_1+b_4 \quad x_2+b_5 \quad x_1 \, x_2$ (Square root)

2. $Y = a+b_1x_1+b_2x_2+b_3 \, x_1^{1.5}+b_4 \, x_2^{1.5} \; b_5 \, x_1x_2$ (Three halves)

3. $Y = a+b_1x_1+b_2x_2 - b_3x_1^2 - b_4 x_2^2 + b_5 x_1x_2$ (Quadratic)

4. $Y = ax_1^{b1} x_2^{b2}$ (Cobb-Douglas)

Where:

Y = is the predicted grain yield of finger millet in $kg.ha^{-1}$

x_1 = is the N applied in kg $kg.ha^{-1}$

x_2 = is the total water applied in $mm.ha^{-1}$

b_1 to b_5 = are the regression coefficients

a = constant derived from regression analysis.

RESULTS AND DISCUSSION

The coefficient of determination and the 'F' test for all the production functions in two seasons are furnished in Table 1. The data showed that out of the functions tried, the quadratic model was found to be the best for prediction purposes, since the magnitude of R^2 values was greater than others. This means that it would fit the data and degree of significance of its terms. It was also observed that the R^2 values for the Cobb-Douglas function was not directly comparable with the others because these values were estimated in logarithmic form.

The regression coefficients of quadratic model are presented in Table 2. The b_1 and b_2 values are the regression coefficients of linear terms of irrigation water and N and b_3 and b_4 are the quadratic terms. The interaction of irrigation water and N ($x_1 . x_2$) was expressed by the b_5 term. This quadratic model accounted for the effect of irrigation water and N in explaining seasonal yield variations. The finger millet (Co 11) showed a marked response to irrigation water applied in both the seasons by having a positive regression coefficient for irrigation water (b_1 values), showing that the grain yield increase was due to adequate availability of irrigation water throughout the crop period. This was also been shown under irrigation at IW/CPE ratio of 0.6 throughout, where the water use efficiency was highest in both the seasons studied. Considering the N requirement, a negative regression coefficient (b_2) was obtained in *Kharif* 1986 indicating that finger millet does not require higher N dose for optimum grain yield. It was also clear that grain yield of finger millet increased only upto 80 $kg.ha^{-1}$ N and later got stabilised. The interaction of irrigation water and N applied regression coefficients (b_5) showed a positive trend in two seasons, thus indicating that the finger millet requires optimum quantities of water and N to increase yield. Hence it was evident that the best prediction model was the quadratic equation, which was found suitable for assessing the impact of irrigation water and N on grain yield of finger millet in *rabi* and *kharif* seasons.

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Table 2. Regression co-efficients for grain yield of finger millet under quadratic model.

Season	Constant	$b_1(x_1)$	$b_2(x_2)$	$b_3(x_1^2)$	$b_4(x_2^2)$	$b_5 x_1x_2$	No. of observations	R^2
Rabi, 1985-1986	-3390.93	+34.8267	+14.5908	-0.0435	-0.0274	+0.0274	30	0.876
		(0.3512)	(1.6926)	(-0.2483)	(-5.3858)	(0.9275)		
Kharif, 1986	-19180.19	+116.21	-31.097	-0.1440	-0.0362	+0.950	30	0.935
		(-3.278)	(2.0712)	(-2.884)	(-2.000)	(-2.176)		

Note : x_1 = Irrigation water ($mm.ha^{-1}$)

x_2 = Nitrogen applied ($kg.ha^{-1}$)

Figures in parenthesis are calculated 't' values.

Table 1. Coefficient of multiple determination (R^2) and 'F' test for square root, three halves, quadratic and Cobb-Douglas functions for finger millet in two seasons.

Season	Particulars	Equation			
		Square root	Three halves	Quadratic	Cobb-Douglas
Rabi, 1985-1986	Coefficient of multiple determination (R^2)	0.8578	0.8700	0.8760	0.8613
	'F' test	Sig.	Sig.	Sig.	Sig.
Kharif, 1986	Coefficient of multiple determination (R^2)	0.9300	0.9300	0.9350	NA
	'F' test	Sig.	Sig.	Sig.	

Sig. = Significant at 5% level
NA = Not analysed in kharif, 1986.

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EFFECT OF TIME OF SOWING ON THE YIELD OF RAINFED WHEAT VARIETIES

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ABSTRACT

The experiment on promising wheat varieties was conducted under three dates of sowing at the Department of Agronomy, Tamil Nadu Agricultural University, Coimbatore on a clay loam soil for five years from 1982-1983 to 1986-1987 under rainfed conditions. The sowing of rainfed wheat during October 8th to 14th proved to be the optimum time of sowing for all the years. Among the varieties HI 617, NI 5439, AKW 65-1 proved better under early sowing (October 8th to 14th). Varieties PBN 22-28, DWR 59 and AKW 65-1 gave more grain yield under normal sowing (October 22nd to 28th). Under later sown conditions, (November 5th to 11th) varieties PBN 22-28, NI 5439, DWR 94 and MACS 1967 were better than others.

KEYWORDS : Sowing Dates, Yield, Rainfed Wheat.