EFFECT OF NUTRITION AS INFLUENCED BY IRRIGATION ON GROWTH AND YIELD OF OIL PALM

(Elaeis guineensis Jacq.)

By

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THESIS

submitted in partial fulfilment of the requirement
for the degree

DOCTOR OF PHILOSOPHY

Faculty of Agriculture

Kerala Agricultural University

DEPARTMENT OF AGRONOMY

COLLEGE OF AGRICULTURE

VELLAYANI, THIRUVANANTHAPURAM

1994
CERTIFICATE

Certified that this thesis entitled "EFFECT OF NUTRITION AS INFLUENCED BY IRRIGATION ON GROWTH AND YIELD OF OIL PALM (Elaeis guineensis Jacq.)" is a record of research work done independently by Sri. P. Thomas Varghese under my guidance and supervision and that it has not previously formed the basis for the award of any degree, fellowship or associateship to him.

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ABSTRACT

A field experiment was conducted in the oil palm plantations of the Central Plantation Crops Research Institute (CPCRI) Research Centre, Palode, Kerala to study the response of mature oil palm to fertilizer and irrigation applications with respect to growth, yield and uptake of nutrients. There were four levels of fertilizers viz: $F_0 - 0:0:0$, $F_1 - 600:300:600$, $F_2 - 1200:600:1200$ and $F_3 - 1800:900:1800$ $\text{g N : P}_2\text{O}_5 : \text{K}_2\text{O palm}^{-1} \text{year}^{-1}$. The three levels of irrigation were: $I_0$ - no irrigation, $I_1$ - 45 l palm$^{-1}$ day$^{-1}$ and $I_2$ - 90 l palm$^{-1}$ day$^{-1}$. The 4x3 factorial experiment was laid out in randomised block design with three replications.

The study was also envisaged to establish the importance of leaf nutrient ratios of yield group of palms and its application in identifying nutrient limitations through the Diagnosis and Recommendation Integrated System (DRIS) approach in oil palm.

The influence of various climatic parameters on yield of oil palm was studied by relating the monthly yield
The yield of palm was found positively correlated with leaf production, leaf area, net assimilation rate, number of bunches produced, vegetative dry matter, P and K in soil and the total uptake of N, P and K by the palm.

Fertilizer application of 1200 g N + 600 g P₂O₅ + 1200 g K₂O palm⁻¹ year⁻¹ was found to improve the growth characters such as annual leaf production, number of leaves on the crown, dry matter production of leaf, trunk and bunches, total dry matter production and the crop growth rate. Increase in yield attributes such as number of female inflorescences, sex ratio, average single fruit weight and the number of bunches at F₂ level contributed to the significantly high FFB yield at F₂ level of fertilizer application. Both palm oil and palm kernel oil production were also maximum at F₂ level.

For the uptake of nutrients N, P and K by palm parts as well as by the palm as a whole, the F₂ level of fertilizer application was found to be the optimum. It was observed that 79% of the total uptake of N, 77% of P and 82% of K are removed annually through leaves and bunches from the system. A K-Mg antagonism was also detected in nutrient uptake.
The yield of palm was found positively correlated with leaf production, leaf area, net assimilation rate, number of bunches produced, vegetative dry matter, P and K in soil and the total uptake of N, P and K by the palm.

Both net income and benefit cost ratio were also found favorable at F₂ level of fertilizer application.

Irrigation at I₂ level has resulted in increased leaf production, leaflets per leaf, leaf area, leaf dry matter, mesocarp dry matter and the bunch dry matter. Physiological parameters like relative water content, leaf water potential, stomatal resistance, leaf temperature and net photosynthesis were all favourable at I₂ level of irrigation.

Female flower production, sex ratio, single fruit weight and number of bunches produced were also more in I₂ treatment. This has resulted in increasing FFB production at I₂ level. Palm oil production was also more at I₂ level. Total uptake of N, P, K and Ca were also found to be maximum at I₂ level of irrigation.
The net profit and benefit cost ratio were also maximum at I$_2$ level.

Leaf nutrient ratios of palms in different yield groups were used to evolve parameters and norms for Diagnosis and Recommendation Integrated System (DRIS) in oil palm. The range of nutrient ratios within the zones of balance, moderate imbalance and imbalance were determined which were also illustrated through DRIS charts for three nutrient combinations. The DRIS approach was used to evaluate the nutrient balancing of the different treatments of the field.

The order of relative importance of the five nutrients was determined using nutrient imbalance index (NII) values as indicated below:

\[ K > P > N > Mg > Ca \]

The $F_2$ level of fertilizer application in the experiment was found to be the most balanced among the tested fertilizer levels. The possibility of magnesium becoming a potential limiting nutrient at higher levels of fertilizer application has been brought out from the study. The
superiority of balanced nutrition in increasing total dry matter production and bunch yield became evident from the study.

The studies on climatic relationship with yield revealed that the pattern of variation in monthly yield remained the same inspite of irrigation throughout the summer months. The relationship of monthly yield of oil palm with monthly climatic parameters was evaluated up to a period 42 months before harvest. When eight climatic parameters were considered together, the influence of these weather parameters at seven specific lag periods viz. 1-4, 9-10, 13-16, 20-23, 25-28, 32-33 and 37-40 were found important for oil palm. Of these the lag 25-28 was found to be the most important as the relationship of climatic parameters with yield at this period was more. Relative humidity, maximum temperature and rainfall were identified as the most important variables influencing palm yield. Using results obtained from regression studies yield prediction models were constituted. It is concluded that yield prediction using the three or more variables is possible for oil palm 26-28 months in advance of harvest.
The salient findings from the study is that a fertilizer dose of 1200g N + 600 g P$_2$O$_5$ + 1200 g K$_2$O palm$^{-1}$ year$^{-1}$ and irrigation level of 90 l palm$^{-1}$ day$^{-1}$ applied through drip system during the summer months are required to obtain maximum FFB yield from mature oil palm.

The order of importance of nutrients for oil palm is determined as K > P > N > Mg > Ca. With the above level of fertilizer application the palms were found to have a more balanced nutrition. However continued application of fertilizers might possibly lead to magnesium deficiency unless corrective measures are adopted.

Relative humidity, maximum temperature and rainfall are found to be the most important climatic parameters influencing oil palm yields. The influence of climatic parameters at seven lag periods 1-4, 9-10, 13-16, 20-23, 25-28, 32-33 and 37-40 were found to be more pronounced on palm yield. From these studies it became possible to predict oil palm yields 26-28 months in advance using models based on these weather parameters.