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**RESEARCH PAPER**

# Effect of Different Methods of Irrigation and Nutrient Requirement on Yield of Oil Palm

**K. Krishna Rao**

Agricultural Research Station, Vijayarai – 534 475,
West Godavari District, Andhara Pradesh, India

## ABSTRACT

**A field experiment was conducted at Agricultural Research Station Vijayarai to study the effect of different methods of irrigation and nutrient requirement on yield of Oil Palm under sandy loam soils of West Godavari Dt., Andhra Pradesh. The irrigation methods are no irrigation ($I_0$), basin ($I_1$) and drip irrigation ($I_2$) as main plot and the four fertilizer levels with no fertilizer ($F_O$), 400:200:900($F_1$); 800:400:1800($F_2$); 1200:600:2700($F_3$) g / N, $P_2O_5$ and $K_2O$ palm/year respectively as sub plot were tried in a strip plot design. Irrigation was scheduled based on the area of basin and mean monthly evaporation per day expressed as liters. The drip and no irrigation palms received half the quantity of water of basin irrigation. The Oil palm was planted on 03-08-1988 and grown under tube well irrigation. Results (2006-2007) showed that the growth parameters were found non significant except plant height. The effect of irrigation and fertilizers on FFB yield was found significant where as the interaction was found non-significant. The irrigation method significantly affected the number of bunches per palm but bunch weight (kg) was found not significant. The drip irrigation ($I_2$) significantly increased the no. of bunches/ palm (6.7) over the no irrigation (5.4) treatment and was at par with basin irrigation (6.6). The basin irrigation ($I_1$) significantly increased the FFB yield (18 t/ha) over no irrigation (13.4 tonnes/ha) and was on par with drip irrigation ($I_2$) with 17.4 t/ha. Graded application of fertilizer levels, significantly increased the plant height. The F3 (1200+600+2700g NPK / ha /year) recorded 8.2 m which was as par with F1 (400+200+900g NPK /palm /year) (7.8m). The FFB yield was increased at higher dose of 1200+600+2700g NPK / palm/year with 18.7 t/ha which was on par with F2 (800+400+1800g NPK/palm/year) with 17.5 t/ha. The water requirement for basin irrigation worked at 509mm and for drip irrigation and life save irrigation treatment received 255mm/year. The water use efficiency was higher in drip irrigation treatmeant with 682.3 Kg–ha/cm. The nutrient use efficiency was higher (82.2Kg/ FFB/ha Kg NPK) in (F1) 400+200+900g NPK/ palm/ year.**

## INTRODUCTION

The non traditional perennial crop of oil palm yields 4-5 tonnes of edible oil from one hectare of land in India and is also seen in the coast line of Andhra Pradesh under irrigated condition with good agronomic management practices. Oil palm crop to yield 9-32 times more oil per hectare per year compared to other traditional annual oil seed crops (Chadha and Rethinam,1991). Andhra Pradesh has been found to have maximum potential area mainly in the four districts of Krishna, East Godavari, West Godavari and Khammam (Rethimam and Chadha 1992). At present the area in Andhra Pradesh is about 65,000ha. Out of 65,000ha 32,000 ha area is under productive stage with average productivity of 6.875 t/ha. There is a need to study the water and nutrient requirement to enhance the yield potential of oil palm crop.

## MATERIAL & METHODS

The investigation was carried out at the Agricultural Research Station, Vijayarai, which is situated in the West Godavari District of Andhra Pradesh, lies between $16^0$-$15^1$ and $17^0$-$30^1$N latitude and $80^0$-$50^1$ and $81^0$-$55^1$E longitude. The annual rainfall is 1067 mm and the soil type is sandy loam. It was laid is Strip plot design in 3 replications with 3 main plot

treatment of irrigation methods and four sub plot treatments of fertilizer levels. The three irrigation methods were no irrigation/life saving irrigation ($I_0$), basin irrigation ($I_1$) and drip irrigation ($I_2$) the four sub plot treatments were fertilizer levels *viz.,* no fertilizer ($F_0$), 400 N; 200 $P_2O_5$; 900 $K_2O$ ($F_1$), 800 N; 400 $P_2O_5$; 1800 $K_2O$ ($F_2$) and 1200 N; 600 $P_2O_5$; 2700 $K_2O$ ($F_3$) g/palm/year respectively. Irrigation was scheduled based on the area of basin and mean monthly evaporation/day expressed as liters. The drip and no irrigation treatmental palms received half the quantity of water of basin irrigation.

Each treatment consisted six palms. Morphological observations like plant height, girth and number of leaves were recorded in each treatment. The yield attributing characters like number of bunches/palm, bunch weight and fresh fruit bunches were recorded in each treatment. The analysis of variance for the both morphological & reproductive parameters was done as per Panse & Sukatme (1985).

## RESULTS & DISCUSSION

### Methods of irrigation

The effects of different treatments on different growth parameters studied are presented in Table 1. Both basin & drip irrigation treatments had taller plants (8.1 and 7.8m) with girth (2.5 & 2.4 m) and number of leaves 36.4 & 35.5 as compared to no irrigation (7.3, 2.4m & 34.9 height, girth and number of leaves respectively), but the differences were not significant.

Drip & basin method of irrigations have shown significantly higher number of bunches/palm (6.7 & 6.6 respectively) as compared to no irrigation (5.4/palm) (Table 1). The bunch weight was found not significant due to methods of irrigation. Basin & drip method of irrigation have significantly increased the FFB yield 146 & 141.1 kg/palm/year respectively as compared to no irrigation with 108.1 kg/palm/year. The basin irrigation treatment recorded significantly highest FFB yield of 18 t/ha and 134% increase in yield over no irrigation (13.4 t/ha). Similarly, the drip irrigation treatment recorded next highest FFB yield of 17.4 t/ha and 130% of increase in yield over no irrigation. The water requirement of oil palm through basin irrigation was recorded as 509 mm where as drip and no irrigation treatments are worked out 255 mm. The drip irrigation has resulted in higher water use efficiency of 682.3 kg/ha-cm. Lowest water use efficiency of 353.6 kg/ha-cm was observed in conventional basin irrigation.

### Fertilizer Levels

The results of fertilizer levels are presented in Table 3. The application of $F_3$(1200;600;2700g NPK/year) fertilizer level has recorded significantly taller plants (8.2m) as compared to no fertilizer (6.9m) (Table 1). The other growth parameters of girth & number of leaves were found not significant. There was a trend of increased girth & more number of leaves with increased levels of fertilizers.

The no of bunches/palm and bunch weight in kg were found non significant. The fertilizer level ($F_3$) has recorded 6.8 as compound to no fertilizer plot (5.8). The bunch weight was recorded maximum in $F_2$ (800;400;1800g NPK/palm/year) with 22.4 kgs as compared to no fertilizer 19.1 kg. The $F_3$ and $F_2$ fertilizer levels showed significantly increased FFB yield of 150.9 & 141.2 kg/palm/year respectively as compared to no fertilizer with 111.6 kg/palm. The $F_3$ level of fertilizer has recorded and produced highest FFB yield of 18.7 t/ha and 136% increase in yield over no fertilizer (13.8 t/ha). Similarly $F_2$ level of fertilizers has recorded next highest FFB yield of 17.5 t/ha and

**Table 1 : Effect of different methods of irrigation and fertilizer levels on plant height, girth and number of leaves at Vijayarai, A.P. (2006-07)**

| Treatment | Plant height in m | Girth in m | Number of leaves |
|---|---|---|---|
| $I_0$ | 7.3 | 2.4 | 34.9 |
| $I_1$ | 8.1 | 2.5 | 36.4 |
| $I_2$ | 7.8 | 2.4 | 35.5 |
| C.D at 5% | NS | NS | NS |
| $F_0$ | 6.9 | 2.4 | 34.3 |
| $F_1$ | 7.9 | 2.4 | 35.7 |
| $F_2$ | 7.8 | 2.4 | 36.3 |
| $F_3$ | 8.2 | 2.6 | 36.1 |
| C.D at 5% | 0.8 | NS | NS |

**Table 2 : Effect of different methods of irrigation & fertilizer on number of bunches/palm, bunch weight in kg, FFB yield kg/palm (kg) and FFB yield T/ha.(2006-07)**

| Treatment | Number of Bunches | Bunch Weight kg | FFB yield kg/palm | FFB Yield T/ha | WUE kg/ha mm |
|---|---|---|---|---|---|
| $I_0$ | 5.4 | 20.1 | 108.1 | 13.4 | 525.5 |
| $I_1$ | 6.6 | 22.2 | 146 | 18 | 353.6 |
| $I_2$ | 6.7 | 21.1 | 141.1 | 17.4 | 682.3 |
| CD | 0.7 | NS | 13.1 | 1.4 | |
| $F_0$ | 5.8 | 19.1 | 111.6 | 13.8 | |
| $F_1$ | 5.9 | 20.8 | 123.4 | 15.2 | |
| $F_2$ | 6.3 | 22.4 | 141.2 | 17.5 | |
| $F_3$ | 6.8 | 22.1 | 150.9 | 18.7 | |
| CD | NS | NS | 20.7 | 1.6 | |

**Table 3 : Fertilizer schedule applied and FUE kg/kg-Fertilizer by different levels.**

| Treatment | FFB yield in kg/ha | Applied NPK kg/ha | | | Total | FUE |
|---|---|---|---|---|---|---|
| | | N | P | K | | |
| $F_0$ | 13800 | | | | | |
| $F_1$ | 15,200 | 50 | 25 | 110 | 185 | 82.2 |
| $F_2$ | 17,500 | 100 | 50 | 220 | 370 | 47.3 |
| $F_3$ | 18,700 | 150 | 75 | 330 | 555 | 33.7 |

**Table 4 : Trends of fresh fruit bunch yield as affected by different irrigation methods & fertilizer levels of oil palm during the period 2003-04 to 2006-07.**

| Treatment | FFB yield in t / ha | | | | |
|---|---|---|---|---|---|
| | 2003-04 | 2004-05 | 2005-06 | 2006-07 | Pooled |
| $I_O$ | 9.2 | 7.4 | 10.5 | 13.4 | 10.1 |
| $I_1$ | 15.1 | 7.2 | 12.6 | 18 | 13.3 |
| $I_2$ | 12.8 | 8 | 11.5 | 17.4 | 12.5 |
| **CD** | **3.1** | **NS** | **1.4** | **1.4** | **1.4** |
| $F_0$ | 10 | 6.5 | 8.5 | 13.8 | 9.7 |
| $F_1$ | 11.5 | 5.7 | 9.7 | 15.2 | 10.5 |
| $F_2$ | 13.4 | 7.9 | 12.2 | 17.5 | 12.7 |
| $F_3$ | 14.6 | 10.1 | 15.8 | 18.7 | 14.8 |
| **CD** | **1.6** | **1.5** | **2** | **1.6** | **1.4** |
| $I_0F_0$ | 9.5 | 6 | 7.9 | 10 | 8.3 |
| $F_1$ | 9.2 | 5.6 | 9.5 | 13.6 | 9.5 |
| $F_2$ | 9.4 | 8.6 | 10.7 | 15.2 | 11 |
| $F_3$ | 8.8 | 9.5 | 14 | 14.6 | 11.7 |
| $I_1F_0$ | 10.7 | 5.4 | 9 | 15.7 | 10.2 |
| $F_1$ | 12.4 | 4.8 | 10.4 | 15.6 | 10.8 |
| $F_2$ | 17.7 | 6.7 | 12.9 | 19.4 | 14.2 |
| $F_3$ | 19.7 | 11.9 | 18.2 | 21.3 | 17.8 |
| $I_2F_0$ | 9.9 | 8.1 | 8.7 | 15.6 | 10.6 |
| $F_1$ | 12.9 | 6.8 | 9.3 | 16.4 | 11.3 |
| $F_2$ | 13.2 | 8.4 | 13 | 17.8 | 13.1 |
| $F_3$ | 15.1 | 8.7 | 15.1 | 20.1 | 14.8 |
| **CD** | **2.8** | **2.5** | **3.2** | **NS** | **1.7** |

**Table 5 : Pooled FFB yield of oil palm irrigation and fertilizer levels (2003-04 to 2006-07).**

| | $I_0$ | $I_1$ | $I_2$ | Mean |
|---|---|---|---|---|
| $F_0$ | 8.3 | 10.2 | 10.6 | 9.7 |
| $F_1$ | 9.5 | 10.8 | 11.3 | 10.5 |
| $F_2$ | 11.0 | 14.2 | 13.1 | 12.7 |
| $F_3$ | 11.7 | 17.8 | 14.8 | 14.8 |
| Mean | 10.1 | 13. | 12.5 | |
| CD at 5%: 1.7 | | | | |

127% increase in yield over no fertilizer (13.8 t/ha). The fertilizer use efficiency was slightly higher in $F_1$(400;200;900g NPK/year) with 82.2 kg FFB yield/ kg NPK/ha. Lowest fertilizer use efficiency was obtained in $F_3$ level fertilizer of (33.7 kg FFB yield/kg NPK/ha).

Subsequent trends in respect of FFB yield as affected by different irrigation methods & fertilizer levels of oil palm during the past four years (from 2003-04 to 2006-07) are presented in table 4. The effect of irrigation methods on FFB yield was found significant in the past four years except 2004-05. The different fertilizer levels were found significant in all 4 years. The interaction was found significant in all the four years except 2006-07.

The basin method of irrigation continued to record increasing trend from 2003 to 2006 except 2004 with respect to fresh fruit bunches. In all the four years, the fresh fruit bunches yield was recorded highest $F_3$ (1200+600+2700g NPK/ palm/ year) over other fertilizer levels. The average of four years data was found significant for both of individual inputs and its combination (Table 5). Perusal of average performance of the past four years indicated similar trend with highest fresh fruit bunches yield of 13.3 t/ha in basin irrigation treatment, 14.8 t/ha in $F_3$ (1200+600+2700g NPK/ palm/ year) level and 17.8 t/ha in combination of basin irrigation with $F_3$ level of fertilizer over no irrigation and no fertilizer treatment (8.3 t/ha). The experimental results reveal that a fertilizer / dose of 1200 + 600 + 2700 g NPK / palm / year with basin irrigation will give the highest yield under agro-climatic conditions of vijairai, West Godavari district, Andhra Pradesh.

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