Critical Input Management for Cultivation of Oil Palm in Konkan Region of Maharashtra

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ABSTRACT

A field investigation was conducted with a view to develop a fertilizer and irrigation package for tenera oil palm in Konkan region of Maharashtra (India). Irrigation given by 'Basin' and 'Drip' increased the number as well as proportion of productive inflorescence significantly over rainfed condition. A combination of drip irrigation and 4.5kg NPK fertilizer mixture in 4:2:9 proportion was most effective and produced 4.85 productive inflorescence with a sex ratio of 33.79 percent. This combination also resulted in higher FFB yield reaching the magnitudes of 138 and 132 kg/palm during the years 1997-98 and 1998-99 respectively. The FFB yields of rainfed crop with zero fertilizers levels during these two years were 3.02 and 8.47 kg FFB per palm, respectively. The yield response of fertilizer levels was quadratic. The optimum dose of NPK mixture fertilizer in 4:2:9 proportion was 2.27, 3.78 and 5 kg per palm per year under 'Rainfed', 'Basin' and 'Drip' irrigation respectively. The drip irrigation assuring a discharge of 70 liters of irrigation water per day during post-monsoon season and giving NPK fertilizer mixture in proportion 4:2:9 @ 4.5 kg per palm per year (1200, 600, 2700 g NPK/palm/ year) secured the total returns of Rs.2, 22,660 with a benefit cost ratio of 0.99 over a cumulative period of 11 years. Cultivation with basin irrigation along with 4.5 kg NPK mixed fertilizer (4:2:9) sustained loss even after 11 years waiting period and is expected to be profitable after 12 years period only. Cultivation of oil palm under rainfed condition was in huge loss (Rs. 95,526/- per hectare) even after 11 years and was not a profitable proposition.

INTRODUCTION

Konkan is a coastal part of Maharashtra and is characterized by high annual rainfall, which ranges from 2500 to 4000 mm with a warm humid climate. It has a hilly topography and soils are laterite and lateritice as well as alluvial coarse shallow type. This region has made greater strides in horticultural crops especially in mango and cashew. The recent studies have indicated that oil palm can also be successfully grown in this region. However, for achieving the potential levels of yields, it is necessary to standardize the levels of critical inputs like irrigation and fertilizers for this crop. According to Rankine and Fairhurst (1999) the crops has a heavy nutrient demand and is highly sensitive to some major nutrients like N, P and K.

The current investigation is aimed at deciding an economically feasible level of fertilizers and the amount and kind of irrigation, which can promote the yield and its components of oil palm favourably.

MATERIALS AND METHODS

In a programme of All India Co-ordinated Research on Oil Palm, a trial on irrigation and fertilizer requirements of tenera oil palm was initiated in year 1989 at Agricultural Research Station, Mulde. The planting was done at 9x9 m spacing on contour on coarse shallow soils having a slope of about 4 to 5 %. The experiment was conducted in a Strip Plot Design with three replications. A fertilizer mixture having N, P and K in a proportion of 4:2:9 was used for giving the fertilizers treatments. Four levels of this mixture viz. 0, 1.5, 3 and 4.5 kg/palm were allocated to vertical strips, whereas three irrigation treatments viz. rainfed condition, basin irrigation and drip irrigation were given to horizontal strips. For each treatment, a unit of six palms was taken as an experimental material. Under basin irrigation, 560 litres of water was given to each palm at an interval of 4 days from cessation of monsoon. In drip irrigation, 70 litres of water was given to each palm/ day during post monsoon season. Though the flowering in experimental palm commenced from year 1991, all the

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flowers were removed as ablation up to 1993. The data on total number of inflorescences and productive inflorescences were recorded from July 1993. The sex ratio was calculated by the formula given below.

Sex ratio = Number of productive inflorescences X 100 Total number of inflorescences

The data pooled over six year i.e. from 1993 to 1999 were subjected for statistical analysis. Significant FFB yields started from the year 1996. Hence, the yield data of the year 1996 to 1999 were subjected to statistical analysis following the method given by Gomez and Gomez (1985). The data on Fresh Fruit Bunch (FFB) yield in response to different fertilizer levels were subjected to regression analysis for fitting suitable polynomial curve. From these equations and on the basis of the cost of fertilizer mixture as well as price of FFB, the optimum dose at which maximum profit is obtained was decided (Nigam and Gupta, 1979). The data on various items of expenditure on cultivation under three different methods of irrigation were recorded for estimating the cost of cultivation over a period of 11 years under consideration. The 'fixed cost' included cost on irrigation system, labour

charges for installation of drip irrigation and basin irrigation, watering by tanker etc. In 'working cost' the items like land development, layout, planting, cleaning, manuring and protection harvesting, transport etc. were included. The land revenue, interest on working capital supervision, cost of depreciation etc. constituted a third major item of expenditure. The total cost of cultivation includes the cost of fixed items, working cost like wages, supervision etc. The total returns were obtained from multiplication of the total FFB yield over 11 years multiplied by the selling price i.e. Rs. 3,000/t. The total returns also included the price of by-products like fire wood forages, leaves of oil palm etc. The net returns and benefit to cost ratio were estimated from total cost and total returns.

RESULTS AND DISCUSSION

Effect of fertilizers and Irrigation

Sex Expression: A large proportion of female inflorescences is considered as the basis for high yield in oil palm. The ratio such productive inflorescences to total inflorescences produced by a plam in a year is conventionally termed as 'Sex Ratio' (Abdul Halim *et al.*,

| Table 1: Effect of irrigation | and fertilizer a | pplication on t | otal infloresce | ence per tenera | a oil palm (averaged over |
|-------------------------------|------------------|-----------------|-----------------|-----------------|---------------------------|
| six years). | | | | | |

| Irrigation | Rainfed | Basin irrigation | Drip irrigation | Mean |
|-----------------------|------------|------------------|-----------------|-------|
| Fertilizers (kg/palm) | | | | |
| 0 | 7.45 | 10.29 | 9.47 | 9.07 |
| 1.5 | 11.26 | 13.55 | 13.18 | 12.66 |
| 3.0 | 11.63 | 14.19 | 14.91 | 13.58 |
| 4.5 | 11.56 | 15.53 | 15.00 | 13.93 |
| Mean | 10.47 | 13.32 | 13.14 | 1000 |
| | Irrigation | Fertilizer | Interaction | |
| S.E.± | 0.42 | 0.74 | 0.99 | |
| C.D. at 5 % | NS | NS | NS | |

Table 2: Effect of irrigation and fertilizer on average number of productive inflorescences per *tenera* oil palm. (averaged over six years).

| | Irrigation | Rainfed | Basin irrigation | Drip irrigation | Mean |
|------|-----------------------|------------|------------------|-----------------|------|
| | Fertilizers (kg/palm) | | | | |
| | 0 | 0.58 | 2.58 | 2.56 | 1.91 |
| | 1.5 | 1.80 | 4.57 | 4.74 | 3.70 |
| | 3.0 | 2.20 | 4.87 | 5.13 | 4.07 |
| | 4.5 | 2.48 | 5.45 | 6.62 | 4.85 |
| 171) | Mean | 1.77 | 4.37 | 4.76 | |
| | | Irrigation | Fertilizer | Interaction | |
| | S.E. ± | 0.36 | 0.42 | 0.61 | |
| | C.D.at 5 % | 0.99 | 1.25 | | |

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| Irrigation | Bainfed | Basin irrigation | Drip irrigation | Mean |
|----------------------|------------|------------------|-----------------|--------------------|
| Fertilizers (kg/pali | m) | Buointinigation | Drip inigation | mouri |
| 0 | 7.76 | 25.07 | 27.03 | 19.95 |
| 1.5 | 15.98 | 33.73 | 35.96 | 28.56 |
| 3.0 | 18.91 | 34.32 | 34.41 | 29.21 |
| 4.5 | 21.45 | 35.78 | 44.13 | 33.79 |
| Mean | 16.03 | 32.23 | 35.38 | noundrinesso Alina |
| | Irrigation | Fertilizer | Interaction | |
| S.E. ± | 0.54 | 0.93 | 1.07 | |
| C.D. at 5 % | 1.49 | 2.27 | | |

Table 3: Effect of irrigation and fertilizer on proportion of productive inflorescences (percent) in tenera oil palm

Table 4: Effect of levels of NPK fertilizer mixture (4:2:9) on yield of fresh fruit bunch (kg/palm) of oil palm under rainfed, basin and drip irrigation conditions.

| Fertilizers (kg/palm) | Rainfed | Basin irrigation | Drip irrigation | Mean | Source | S.E. <u>+</u> | C.D at 5 % |
|--------------------------|---------|---------------------|--------------------|-------|------------|---------------|-------------------|
| 0.1 | 6.18 | 15.56 | 11.26 | 11.00 | Irrigation | 3.65 | 14.33 |
| 1.5 | 18.10 | 40.37 | 54.33 | 37.60 | Fertilizer | 3.09 | 10.69 |
| 3.0 | 19.49 | 54.08 | 80.54 | 51.37 | I x F | 6.88 | 21.14 |
| 4.5 | 18.66 | 51.16 | 76.21 | 48.68 | | | |
| Mean | 15.60 | 40.29 | 55.58 | 37.16 | | | |

Year - 1997 - 98

| Fertilizers | Rainfed | Basin | Drip | Mean | Source | S.E. + | C.D at 5 % |
|-------------|---------|------------|------------|-------|------------|--------|------------|
| (kg/palm) | | irrigation | irrigation | | | | |
| 0.1 | 3.02 | 50.51 | 33.52 | 29.02 | Irrigation | 4.20 | 16.48 |
| 1,5 | 37.57 | 84.62 | 88.27 | 70.15 | Fertilizer | 4.18 | 14.45 |
| 3.0 | 39.03 | 101.36 | 111.60 | 84.00 | I x F | 7.25 | 22.26 |
| 4.5 | 28.94 | 11681 | 138.01 | 94.58 | | | |
| Mean | 27.14 | 88.33 | 92.85 | 69.44 | | | |

Year - 1998 - 99

| Fertilizers | Rainfed | Basin | Drip | Mean | Source | S.E. <u>+</u> | C.D at 5 % |
|-------------|---------|------------|------------|-------|------------|---------------|------------|
| (kg/palm) | | irrigation | irrigation | | | | |
| 0.1 | 8.47 | 68.10 | 52.95 | 43.17 | Irrigation | 5.21 | 20.45 |
| 1.5 | 46.76 | 104.42 | 111.16 | 87.45 | Fertilizer | 5.95 | 20.58 |
| 3.0 | 31.04 | 121.08 | 86.19 | 79.44 | I x F | 10.05 | N.S. |
| 4.5 | 31.11 | 118.54 | 132.71 | 94.12 | | | |
| Mean | 29.35 | 103.04 | 95.75 | 76.05 | | | |

1988). Irrigation and fertilizer treatments showed a characteristic effect on the sex ratio and its two determinants.

Under unirrigated condition, the palms without fertilizers produced very few inflorescences (7.45) (Table 1) out of which hardly 7.76 percent were productive (Table 2). Irrigation given either by 'basin' or by 'drip' method had no significant effect on total number of inflorescences; however, it's influence on number of productive inflorescences and sex ratio was significant. Further, basin and drip irrigation were equally effective for increasing the number of productive flowers, whereas the average sex ratio was significantly higher under drip irrigation (35.38) than under basin irrigation (32.23).

Fertilizer application increased the number and proportion of productive inflorescences significantly

(Table 3). However, it did not have influence on total number of inflorescences. With every additional level of fertilizers there was a gradual increase in number of productive inflorescences and in sex ratio. At zero fertilizer level, the average number of productive inflorescences was 1.91 with a sex ratio of 19.95 percent. At 4.5 kg level of NPK mixture per palm, the average number of productive inflorescences increased to 4.85 with a sex ratio of 33.79 percent. A combination of 'drip' irrigation and 4.5 kg NPK fertilizer mixture/palm was most effective as it resulted in emergence of maximum number of (6.62/palm) and percent proportion (44.13) of productive inflorescences. The studies thus revealed that emergence of productive inflorescences and it's high proportion to total number of inflorescences could be successfully managed by irrigation and fertilizer application.

FFB Yield (Kg/palm/Year): The oil palm plantation under investigation attained an age of seven years by 1996. The overall average yield at this stage was 37.16 kg/palm. In next two years the average yields were 69.44 and 76.05 kg/palm respectively. Thus with advancement in age, the yield levels increased remarkably (Table 4). 'Basin' as well as 'drip' irrigation showed significant increase in FFB yield

Table 5: Optimum dose of fertilizer mixture (kg/palm) and maximum net profit (Rs./palm) under rainfed, basin and drip irrigation in *tenera* oil palm.

| | | | Year | | | Mean |
|----------------------|-----------|---|---------|---------|---------|--------|
| | | | 1996-97 | 1997-98 | 1998-99 | |
| I. Rainfed | | 0 | | | | |
| Optimum dose (kg | g/palm) | | 2.03 | 2.305 | 2.48 | 2.27 |
| Maximum profit (F | Rs./palm) | | 14.60 | 53.92 | 75.90 | 48.14 |
| II. Basin irrigation | | | | | | |
| Optimum dose (ko | g/palm) | | 3.11 | 3.16 | 5.07 | 3.78 |
| Maximum profit (F | Rs./palm) | | 81.91 | 108.64 | 92.33 | 94.31 |
| III. Drip irrigation | | | | | | |
| Optimum dose (ko | (palm) | | 3.53 | 6.405 | 5.52 | 5.00 |
| Maximum profit (F | Rs./palm) | | 146.64 | 129.76 | 11.78 | 162.73 |

Table 6: Abstract of the cost of cultivation (Rs./ha) of *tenera* oil palm over 11 years from planting at A. R.S. Mulde. (Maharashtra)

| Sr. | Particulars | | Cost Rs / ha | |
|------|--|--------------------|---------------------|--------------|
| No. | | Drip irrigation | Basin irrigation | Rainfed |
| 1 | Fixed Cost Including cost of pump set, accessories and labour charges for installation and water through tanker in rainfed palms etc. | 25,065 /- | 15,970/- | 2,106/- |
| П | Working Cost Labour charges for land preparation, planting, harvesting etc. and cost of fertilizers, pesticides and transport etc. | 1,20,712/- | 1,20,712/- | 1,16,632 /- |
| Ш | Total input cost (I + II) | 1.45,777/- | 1,36,682/- | 1,18,648/- |
| IV | Depreciation, land revenue, interest on working and fixed capital, rental value and supervision charges etc | 79,874/- | 68,164/- | 43,538/- |
| v | Total Cost III + IV | 2,25,651/- | 2,04,846/- | 1,62,186/- |
| VI | Gross returns over 11 years including income from FFB, Fire wood material, grasses and leaves. | 2,22,660/- | 1,77,660/- | 66,660/- |
| VII | Net returns over 11 years | (-) 2,991/- | (-) 27,186/- | (-) 95,526/- |
| VIII | Cost Beriefit Ratio | 0.99 | 0.87 | 0.41 |

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in comparison with rainfed condition during all the three years. The difference in yield due to these two treatments was significant in year 1996, but in next two years these two treatments were at par.

Yield response to fertilizers was significant during all the three years and was of quadratic nature. The interaction between irrigation and fertilizers was significant during first two year. A combination of 'drip' irrigation and 4.5 kg NPK mixture/palm was most effective, which gave 138 and 132 kg FFB yields during 1997-98 and 1998-99 respectively.

The quadratic response provided a scope for determining the optimum level of fertilizers at which maximum profit can be obtained. The average optimum dose of fertilizer mixture in 4:2:9 proportion of NPK was 2.27, 3.78 and 5 kg per palm per year under 'rainfed', 'basin', and 'drip' irrigation treatments respectively (Table 5).

Economics of oil palm cultivation in Konkan

From the data in Table 6, it is revealed that the oil palm cultivation in Konkan region was remunerative after a period of 11 years from planting only under drip irrigation assuring the daily water discharge of 70 litres/palm in post monsoon season along with a common dose of 4.5 kg NPK mixture (1200+600+2700 g N, P and K) per palm per year in the form of Urea, Single super phosphate and Muriate of potash. The total cost of cultivation by this period was Rs. 2,25,651/ha with the total returns of Rs. 2,22,660/ha. The benefit to cost ratio was 0.99. In further course of time the crop is expected to produce 16 t/h of FFB yield fetching a reasonable remuneration.

Oil palm cultivation under 'basin' irrigation went in loss of Rs.27,186/ha even after a waiting period of 11 years. The total cost of cultivation during the period was Rs. 2,04,846 with a total return of Rs.1, 77,660/ha. considering an average FFB yield of 13 to 15 t/ha. The crop under 'basin' irrigation is expected to be remunerative after a 12 years waiting period from planting. A common dose of NPK @ 1200, 600, 2700 g/palm/year i.e.4.5kg NPK mixture and 560 litres of irrigation water at 4 days interval per palm in basins is essential for this purpose.

The cultivation of oil palm under rainfed condition went in huge loss (Rs. 95,526/ha) even after a waiting period of 11 years.

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