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RESEARCH PAPER

Influence of Fertigation on Growth and Yield of Oil Palm

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ABSTRACT

Oil palm is a gross feeder and demands a balanced supply of nutrients for growth and yield.The present study has been taken up to standardize the fertilizer dose and improve nutrient use efficiency in oil palm. Six fertigation treatments were imposed in an adult plantation in a Randomized Block Design. Palms fertilized with 300-150-300 g NPK/palm/year recorded the lowest photosynthetic rate while the highest photosynthetic rate was observed in palms treated with 900-450-900 g NPK/palm/year. Palms treated with 1200-600-1800 g NPK recorded highest FFB yield and bunches while the lowest was recorded in 1200-600-1200 g NPK/palm/year through soil application. The results indicated that fertigation could be cost effective and increase productivity of oil palm.

INTRODUCTION

Oil palm is a gross feeder and demands a balanced and adequate supply of nutrients for growth and yield. Manuring generally represents the single largest cost component (65 percent of total cost). It is a proven fact that annual allocation of fertilizers at a daily dosage to individual palms would lead to substantial improvement in yields. But the method adopted has to be cost effective and less dependent on labour. Fertilizer savings through fertigation can be to the tune of 25-50 percent (Haynes, 1985). Under drip irrigation, only a portion of the soil volume around each plant is wetted and thus traditional methods of fertilizer application are ineffective. The limited root zone and reduced amount of mineralization are the main reasons for reduced nutrient availability to the plants compared to that of normal method of fertilizer application under drip irrigation (Magen, 1995).

Fertigation has been proven successful in a wide range of horticultural crops particularly in fruit crops like citrus (Boman, 1996; Shrigure *et al.,* 2000; Swietlik, 1992), grapes (Spayd *et al.,* 1994) and date palm (Reuveni, 1991). Fertigation of nutrients with great dilution during irrigation increased the fertilizer use efficiency far beyond the previously possible level (Menzel and Obe, 1990). The time of K application had less effect on tomato yield than N application, when both were applied through drip irrigation (Dangler and Locascio, 1990). No differences in yield of strawberries was recorded, when N and K were applied either daily or at weekly intervals with drip irrigation (Locascio *et al.,* 1977). Multiple application of N fertilizers through drip irrigation did not improve the efficiency of fertilizer uptake by tomatoes over a single injection (Miller *et al.,* 1981).

Fertigation can economize the use of water and fertilizer with a corresponding lowering of cost of production and labour towards weeding, fertilization and water application (Mahalakshmi *et al.,* 2001). Fertigation, which combines irrigation with fertilizers, is well recognized as the most effective and convenient means of maintaining optimum fertility level and water supply according to specific requirement of each crop, resulting in higher yields and better quality of fruits (Smith *et al.,* 1979; Syvertsen and Smith, 1996). Solamlai *et al.* (2005) also reviewed the fertigation aspects in high value crops. Fertigation techniques have not been standardized in oil palm under Indian conditions for increasing the production and productivity. Hence, the present study has been taken up to standardize the fertilizer dose and improve nutrient use efficiency through fertigation.

METHODOLOGY

The study was conducted at Directorate of Oil Palm Research, Pedavegi, which is situated in West Godavari District of Andhra Pradesh in India. The experimental site (Pedavegi) is located at 16^0 43'N and 81^0 09'E with a mean sea level of 13.41 m. The average rainfall is 1,221 mm. Seven treatments were imposed in an adult plantation (four replications) in a Randomized Block Design.

Details of the fertigation treatments (g/palm/year)

	N	P	K
T1	300	150	300
T2	600	300	600
T3	900	450	900
T4	1200	600	1200
T5	1200	600	1800
T6	1200	600	2700
T7 (soil)	1200	600	1200

Gas exchange parameters like net photosynthetic rate, transpiration and stomatal conductance were recorded using a portable photosynthesis system (*LCA-4, ADC*, Hertfordshire, UK) connected to a PLC 4 (6.25 cm^2) leaf chamber. Yield parameters (number of bunches and bunch weight) were recorded in all the treatments.

RESULTS AND DISCUSSION

The soil analysis indicated that the soil pH ranged from 6.23 to 7.89 and EC was between 0.103 and 0.631 dS/m. Organic carbon in the different depths was between 0.5 and 2.7 percent. The phosphorus contents were very high and potash levels varied from low to high.

The height of the palms ranged from 4.03 to 4.83 m, while girth ranged from 2.44 to 2.63 m. There were no significant differences in terms of height, girth and number of leaves among the different fertigation treatments. Fertigation could be effective in increasing the vigor of the plants as measured by plant girth, number of leaves and phyllochron. The increasing level of fertigation gave significant increase in height of the plant in banana. The water use efficiency in conventional irrigation (470 kg/ha mm) was increased to 570 kg/ha mm in subsurface drip fertigation system.

The photosynthetic rate ranged from 10.61 to 16.55 μmol m^{-2} s^{-1} in the different treatments. Palms in T1 recorded the lowest photosynthetic rate, while the highest photosynthetic rate was observed in palms of T3. The transpiration and conductance were highest in palms treated with T4 and lowest transpiration rate was observed in palms of T1 (Table 1). The FFB yield ranged from 26.45 to 32.42 t/ha in the different treatments (Fig. 1). This might be due to the better

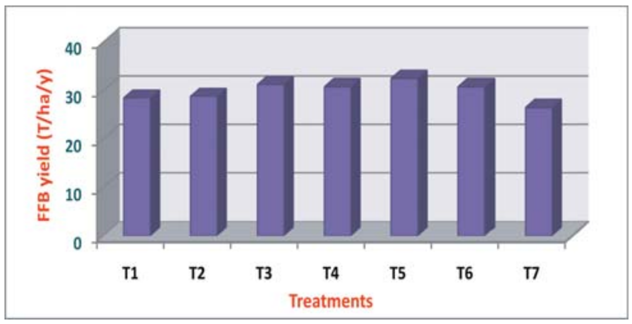

Fig. 1: FFB yield in different fertigation treatments

Table 1: Leaf exchange characters in the different fertigation treatments

Treatments	Photosynthetic rate (μmol m^{-2} s^{-1})	Stomatal conductance (μmol m^{-2} s^{-1})	Intercellular CO_2 conc. (ppm)	Transpiration rate (μmol m^{-2} s^{-1})	Leaf temperature (°C)
T1	10.61	0.13	213.0	3.59	35.90
T2	14.95	0.24	241.3	5.61	34.65
T3	16.55	0.22	224.6	5.04	34.57
T4	15.32	0.24	245.1	6.15	35.31
T5	15.55	0.22	238.8	5.07	35.03
T6	14.45	0.22	245.8	5.18	34.41
T7 (soil)	11.84	0.17	239.1	4.40	34.99
LSD (p=0.05)	2.05	0.04	11.4	0.82	0.46

physiological efficiency of the plant owing to supply of nutrients and water in splits through fertigation.

Palms in T5 recorded highest FFB yield and bunches, while the lowest FFB yield and bunches were recorded in T7. Application of N through fertigation performed better than soil application alone. When N was fertigated, N saving was to the tune of 20 percent compared to soil application in tomato (Haroon, 1991). Application of 75 percent of recommended dose through fertigation with 20 percent wetting gave the maximum yield (19.35 kg/plant) without affecting fruit quality in pomegranate. In a three year old plantation of guava, fertigation at 75 percent recommended NK level with urea and multi - K gave 12.3 percent higher yield than soil application at 100 percent NK level indicating a saving of 25 percent NK in addition to improvement in productivity. Fertilizer saving through fertigation was found to the extent of 50 percent with yield increase in peaches (Bussi *et al.,* 1991). In coconut, fertigation with water soluble fertilizer at 80 percent recommended fertilizer improved trunk girth (6 percent), number of fronds (18 percent), fruit bunches (21.5 percent), nut yield and economized 20 percent fertilizer over control. Gnanamurthy and Manickasundaram (2001) reported that fertigation in oil palm with water soluble fertilizer improved the trunk girth, number of fronds and yield with a saving in fertilizer and water by 20-33 per cent over control.

It is quite clear from the study that, fertigation had many advantages like higher water use efficiency and fertilizer use efficiency, minimum losses of N, optimization of the nutrient balance by supplying nutrients directly to root zone, control of nutrient concentration in soil solution, saving application costs and increased productivity of oil palm.

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