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RESEARCH PAPER

Effect of Fertigation on Growth and Vigour of Oil Palm Seedlings

K. Ramachandrudu*, K. Suresh, G. Sekhar and V.Suneetha

Directorate of Oil Palm Research, Pedavegi, Andhra Pradesh
*chandrakr2000@yahoo.com

ABSTRACT

The performance of oil palm seedlings grown under fertigation was evaluated at Directorate of Oil Palm Research, Pedavegi, Andhra Pradesh. Fertilizers were applied at weekly intervals through drip system of irrigation @ 25 per cent, 50 per cent, 75 per cent and 100% of recommended dose of fertilizers (RDF) along with the control. Significant results were found among the treatments for most of the parameters studied. Among the treatments, seedling treated with 50 per cent RDF had significantly better for seedling height, number of leaves, leaf area, stem girth, number of primary roots, root volume and total dry biomass production as compared to other treatments. Higher accumulation of nutrients in potting mixture and leaf was observed under 100 per cent RDF-fertigation though it did not reflect in terms of growth and total biomass production. Fertilizers @ 50 % of RDF can be applied for raising oil palm seedlings due to better growth and vigour.

Key words : Fertigation, seedlings, oil palm

INTRODUCTION

Oil palm, a perennial crop, which is committed to the land for nearly 25-30 years, an assurance of quality planting material is essential for oil palm (Sunitha *et al*., 2006). The growth and productivity of oil palm is mainly dependent on the quality of seedlings which are raised in poly bags for a period of 12-14 months under specific management. The health and vigour of oil palm seedlings is mainly decided by water and nutrient management. At present, 194g of chemical fertilizers/seedling/year (Anonymous, 2000) are applied manually at monthly/fortnight intervals, which is laborious and expensive practice. The cost of production of oil palm seedlings has been increased exorbitantly owing to high cost and non availability of labour along with expensive chemical fertilizers. The major drawbacks of the conventional practice of applying fertlizers are low fertilizer use efficiency, labour intensive, tedious and difficult to supervise in large nurseries as the frequency of application is more. So, there is an urgent need for cost effective techniques preferably fertigation in oil palm nursery. Application of fertilizers along with irrigation maintains an optimum level of nutrients within the root zone (Fen and Mackenzie, 1993). It also improves fertilizer use efficiency, saves fertilizers, time, labour and also helps in uniform and precise application of nutrients in the effective root zone resulting in higher productivity and quality production. As there is no information on impact of fertigation on growth of oil palm seedlings, the present experiment was conducted for quantifying the optimum dose of fertilizers and studying the effect of fertigation on growth and vigour of oil palm seedlings.

MATERIALS AND METHODS

The study was conducted for a period of 12 months at Directorate of Oil Palm Research, Pedavegi, Andhra Pradesh. The experiment was laid out in completely randomized design (CRD) with five treatments and ten replications. The treatments were T1 - Control-manual application of recommended dose of fertilizers (RDF) - 30gN, 38gP and 25gK/seedling/year, T2 - 25 per cent RDF, T3 - 50 per cent RDF, T4 - 75 per cent RDF and T5 - 100 per cent RDF. Source of fertilizers were diammonium phosphate (DAP) and NPK complex (17:17:17) which were applied manually

at fortnight interval and weekly interval through drip system of irrigation since both the fertilizers are water soluble. The fertilizer application was commenced from the second month onwards and continued till 11th month. DAP was applied manually in liquid form to the seedlings during the first four months in T2, T3, T4 and T5 whereas complex fertilizers were injected into drip during the next six months.

Sixty five day old uniform seed sprouts of hybrid (14Dx15P) belonging to oil palm seed garden, Pedavegi were used for the study. The potting mixture consisted of tank silt and FYM mixed in 2:1 ratio by volume. Seedlings were raised in double stage nursery system and all the recommended operations were carried out. Water was given to nursery daily except on rainy days. Observations on growth parameters i.e., seedling height, number of leaves/seedling, 3rd leaf length and breadth, stem girth, rachis depth, rachis width, number of leaflets/leaf, leaflet length and width were recorded using standard methods at three month interval. Destructive analysis was done on 12 month old seedlings and observations on number of primary roots/seedling, root volume, fresh and dry weight of shoot and roots and total dry matter were recorded. Soil samples of all the treatments were collected and analyzed for pH, EC, OC, P and K by using standard methods (Tandon, 2005). Similarly, leaf samples (3rd leaf from the top) from each treatment were collected and analyzed for N, P and K using standard methods (Tandon, 2005). The data were analyzed statistically using the standard method (Gomez and Gomez, 1984).

RESULTS AND DISCUSSION

A perusal of the data presented in Table 1 showed that results were found significant among the treatments for all the growth characters studied. The treatment T3 (137.56 cm) which was significantly superior to other treatments recorded the maximum seedling height whereas the minimum seedling height was observed in T5 (96.11cm). Similarly, seedlings grown under T3 (21.75) possessed the highest number of leaves and it was found on par with T2 (21.25) while the lowest number of leaves was noted in T5 (18.25). The number of leaves in T5 and T1 were found on par with each other. The leaf area was maximum in T3 (4513.17 sq.cm) and minimum in T5 (2523.95 sq.cm). The treatments T2, T4 and T1 were on par with one another. The maximum and minimum rachis depth and rachis width were observed in T2 and T1, respectively. There were non significant results among the treatments T2, T3 and T4 for rachis depth and rachis width. Seedlings with maximum stem girth were noticed under T3 (29.67 cm) which was significantly superior to other treatments while it was the minimum in T5 (22.20 cm). The vigour of oil palm seedlings is normally judged in terms of seedling height, number of leaves and stem girth. The enhanced vegetative growth of seedlings under T3 may be attributed to better assimilation of nutrients and higher photosynthetic rate. The excess concentration/toxicity of nutrients in the medium might have retarded seedling growth with T5. The treatment T5 (37.75) and closely followed by T2 (37.50) produced the highest number of primary roots. Among the treatments, T3 was found significantly superior in respect of root volume (531.25 cu.cm). The treatment T5 recorded the lowest number of primary roots/ seedling (28.50) and the minimum root volume (203.75 cu.cm).

There were significant results (Table 2) among the treatments for biomass production. The maximum fresh weight of shoot was recorded in T2 followed by T3. However, the treatment T3 was markedly superior to other treatments in respect of shoot dry weight (515.65 g). Improved dry shoot weight under T3 is directly related to better vegetative growth particularly more number of leaves and big size stem. Fresh root weight (486.25 g) and dry root weight (162.28 g) were significant in T2 when compared to that of other treatments. This may be due to better partitioning of photosynthates towards roots as compared to other

Table 1: Effect of different fertigation levels on growth of oil palm seedlings

Treatment	Seedling height (cm)	Leaves	3rd Leaf area (sq.cm)	Rachis depth (cm)	Rachis width (cm)	Stem girth (cm)	Primary roots	Root volume (cc)
T1	116.64	18.75	2955.90	2.97	1.77	27.05	32.25	382.50
T2	128.38	21.25	3074.11	3.35	2.12	27.86	37.50	491.25
T3	137.56	21.75	4513.37	3.17	1.97	29.67	37.75	531.25
T4	114.97	20.25	2874.12	3.15	2.05	25.32	32.25	275.00
T5	96.11	18.25	2523.95	3.00	1.85	22.20	28.50	203.75
CD (P=0.05)	3.70	0.93	200.42	0.21	0.15	1.76	2.46	20.52

treatments. Overall, total fresh biomass and total dry biomass were the maximum in T2 and T3, respectively. But the results for total dry biomass were found on par with each other between T3 (628.89 g) and T2 (620.21 g). The minimum values for both fresh and dry weight of shoot and roots and total fresh (1.09 kg) and dry biomass (393.79 g) were obtained in T5. The results for total dry biomass were found non significant between T1 and T4. The maximum quantity of dry matter at T3 can be ascribed to better photosynthetic efficiency which in turn ensured greater synthesis, translocation and accumulation of carbohydrates.

Results (Table 3) for nutrient contents in medium and leaf were found significant among the treatments except pH and EC. The fertigation treatments did not have any effect on potting mixture pH and EC. More organic carbon, phosphorous and potassium in potting mixture was estimated in T5 and it was on par with RDF-manual in case of nitrogen and potassium. Less organic carbon, phosphorous and potassium in medium were observed in T3 and this may be due to better uptake of nutrients by seedlings. Uptake of N, P and K is commonly higher with fertigation than from the use of similar rates of solid fertilizers (Dasburg *et al*., 1988). The treatment T5 recorded the highest (2.87 %) concentration of nitrogen in leaf and the lowest (2.59 %) leaf nitrogen was observed in T1. The treatments T5, T4 and T3 were found on par with one another for leaf nitrogen. More phosphorous content in leaf was obtained in T3 (0.33 %) and T2 (0.30 %) whereas it was less in T4 (0.23 %). The level of potassium in leaf under the treatment T5 was markedly higher than that of other treatments. It is evident from the results that there was a positive relationship between increased N and K availability in potting mixture and higher N and K accumulation in leaf under T5. However, the enhanced level of nutrients must be luxury consumption as it was not reflected in terms of biomass production. This may indicate that NPK concentration levels in leaf under T3 must be the optimum for better growth of seedlings. Favourable soil moisture availability due to regular watering and high dose of chemical fertilizers under T1 (Control) in confined medium could be the main reasons for enhanced levels of nutrient availability in the medium.

The continuous supply of water and nutrients in soluble form to the root zone might have favoured the vigorous growth of seedlings under fertigation particularly particularly in T2 and T3. It is clear from the results that there was a positive response of fertilizers on the growth and biomass production up to T3 and then onwards, there was decline in growth and biomass production due to imbalanced nutrition or toxic concentration at higher doses. The excess accumulation of nutrients both in potting mixture and leaf in T5 might had caused deleterious effect on the seedling growth. Results indicated that T3 might be an optimum dose for raising quality seedlings. Relatively, fertigation is the most efficient way as it economised manual labour requirement and fertilizer quantities (data not shown) and ensured that fertilizer reached the plant in balanced and efficient way. From the above results and discussion, it can be concluded

Table 2: Effect of different fertigation levels on biomass production in oil palm seedlings

Treatment	Shoot fresh weight (kg)	Shoot dry weight (g)	Root fresh weight (g)	Root dry weight (g)	Total fresh biomass (kg)	Total dry biomass (g)
T1	1.50	401.40	245.25	86.69	1.75	488.09
T2	1.84	457.92	486.25	162.28	2.32	620.21
T3	1.67	515.65	340.00	113.23	2.01	628.89
T4	1.46	402.35	181.25	70.82	1.64	473.18
T5	0.94	334.47	143.75	59.31	1.09	393.79
CD (P=0.05)	0.17	47.34	39.25	14.26	0.18	50.42

Table 3: Effect of different fertigation levels on nutrient contents in potting mixture and leaf

Treatment	Potting mixture					Leaf (%)		
	pH	EC (mS)	OC (%)	P (kg/ha)	K (kg/ha)	N	P	K
T1	7.57	0.40	1.71	225.37	289.65	2.59	0.26	1.29
T2	7.74	0.38	1.66	207.70	278.15	2.64	0.30	1.32
T3	7.55	0.38	1.42	177.65	219.97	2.66	0.33	1.29
T4	7.74	0.35	1.52	193.30	259.92	2.71	0.23	1.37
T5	7.52	0.35	1.81	300.62	295.22	2.87	0.27	1.46
CD (P=0.05)	NS	NS	0.20	18.89	17.00	0.20	0.03	0.05

that fertilizers at the rate of 50 per cent of recommended dose can be applied as they showed promising results in important characters like seedling height, leaf and root production, stem girth and total dry biomass production.

REFERENCES

Anonymous. 2000. Oil palm nursery manual. Published by National Research Centre for Oil Palm, pp.25.

Dasburg, S., Barakia, A., Spazisky, S. and Cohen, A. 1988. Fertigation versus broadcasting in an orange grove. *Fertilizer Research*, **15**: 147-154.

Fen, M.X. and Mackenzei, A.F. 1993. Urea and phosphate interactions in fertilizer microsites: Ammomnium volatilization and pH changes. *Soil Sci. Soc. Amer. J.* **57**: 839-45.

Gomez, K.A. and Gomez, A.A. 1984. Statistical Procedurs for Agricultural Research. John Wiley and Sons, New York.

Sunitha, S., Thomas Varghese, P. and Pannerselvam, P. 2006. Evaluation of different potting mixtures on growth and vigour of oil palm seedlings in nursery. *Int. J. Oil Palm*, **5**: 33-36.

Tandon, H.L.S. 2005. Methods of Analysis of Soils, Plants, Water, Fertilizers and Organic Manures. Fertilizer Development and Consultation Organization, New Delhi.