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Fertigation schedule for the cultivation of Tenera oil palm in Konkan Coastal Region of Maharashtra

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Oil palm is recognised as the major source of vegetable oil with an average oil yield of 4 to 6 tonnes/ha. However, the crop has heavy nutrient demand and high degree of response to major nutrients like N, P and K. Oil palm is known for its exceptionally high oil yield as compared to the traditional oilseed crops and has wide adaptability to different climatic and soil conditions. Therefore, it could be considered as one of the most important source to meet the challenges of edible oil demand arising due to ever increasing population as well as per capita consumption of edible oil in near future. According to Kalidas *et al*. (2014), the supply of vegetable oil has increased at the rate of 2 % per annum in the past 25 years, while demand grew at the rate of 5 % per annum. For a projected Indian population of 1685 million by 2050, 17.84 million tonnes of vegetable oil is required to meet the fat nutrition. This is equivalent to roughly 59.41 million tonnes of oilseeds. If 25 % of vegetable oil is met from crops other than annual oilseeds, then the country needs to produce just 44.56 million tonnes of oil seeds by 2050 to meet fat nutrition of the projected population. Oil palm is likely to play a major role in augmenting the supply of 25 % vegetable oil in the country. By 2050 even if an area of 8 lakh ha is covered under oil palm, the country must be able to produce about 3.2 MT of oil.

The palm oil is derived from the fleshy mesocarp of the fruit, which contains about 45-55 % of oil. The palm kernel oil, obtained from the kernel of stony seed, is a potential source of lauric oils. Palm oil has good acceptance as a cooking medium because of its price advantage. The per capita edible oil consumption in India (14.5 kg in 2012-2013) has been steadily rising over the decades but is still short of the average worldwide consumption in the developed countries. Especially the below poverty line population lags far behind in terms of per capita edible oil consumption and therefore is a major reason for widespread malnutrition (Singh 2014). Inadequate consumption of edible oils the root cause behind this. Palm oil is an important source of carotenoids (pro-vitamin A), tocols (Vitamin E), sterols, essential fatty acid and is cost effective in comparison to other edible oils.

It is good raw material for manufacturing oleo chemicals used in making soaps, plasticizers etc. (Arulraj 2015). Irrespective of soil and climate, fertilization is essential in oil palm cultivation if maximum growth and production potential is to be achieved (Caliman 2009). The high productivity of oil palm has been demonstrated in well managed plantations of India and maximum yield of 53.29 t FFB/ha/year has been reported at DOPR during 2012 (Annon. 2012). Out of the major practices that are responsible for yield improvement, nutrient management by fertilizer application is the most important contributor accounting for 26% of the fresh fruit bunches (FFB) yield increment in oil palm as compared to unfertilized palms (Prasad *et al.* 2012). General fertilizer recommendation suggested by Gawankar *et al*. (2010) for oil palm cultivation under Konkan conditions through soil application is 1.2: 0.6: 2.7 kg NPK/palm/year. The application of fertilizers through soils during rainy season will result in leaching of nitrogenous and potassic fertilizers. The advantage of fertigation over conventional method was emphasized by Maheswarappa and Rajkumar (2014), they compiled the research achievements on effect of fertigation in oil palm and reported that fertigation of 1.2 : 0.6 : 1.2 kg NPK/palm/year through drip in 6 equal splits was found optimum for oil palm under irrigated condition of Tungabhadra Commend Area similarly, the results of the trial conducted at Agricultural Research Station, Pattukkottai (Tamilnadu) revealed that fertilizer application of 1.200 : 0.600 : 1.200 kg NPK/palm/year through micro-irrigation technique recorded more stem girth, number of leaves/palm and FFB yield in oil palm. At Horticultural Research Station Vijayarai

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the fertilizer dosages of 1.2 : 0.6 : 1.2 kg NPK/palm/year through fertigation recorded maximum FFB yield of 124.7 kg/palm/year in oil palm. Fertilizer application through drip system is an effective method saving fertilizer cost, reduces labour requirement and supply nutrients according to the crop demand. Subramanian *et al*. (2012) demonstrated drip fertigation as one of the options to increase the fertilizer use efficiency in coconut. Keeping this in view current investigation was carried out to study the effect of fertigation on the fresh fruit bunch yield of 18 years old tenera oil palm orchard.

The experiment was conducted at the Agricultural Research Station, Mulde Tal: Kudal, District Sindhudurg (Maharashtra), South Konkan coastal region of Maharashtra under All India Coordinated Research Project on Palms. The experimental site is located at 17 m above mean sea level having hilly topography and lateritic to alluvial coarse shallow soil type. The field experiment was laid out in a randomised block design with three replications. Experimental palms planted at 9 m × 9 m on contour and grew under different fertilizer doses in fertilizer trial conducted during 1990 to 2008 were used for the study. Six different dosage of fertilizers were applied through the drip system by means of venturi and compared with fertilizer dose of 1.2: 0.6: 2.7 kg NPK/palm/year through soil application as recommended by Gawankar *et al.* (2010) on 18 years old tenera oil palm orchard which was earlier. The treatments were given in six equal splits bi-monthly in a year in the form of urea, diammonium phosphate (DAP) and muriate of potash (MOP). The three years period, i.e. from 2009 to 2011 was considered as transition period and FFB yield harvested during the 2011-12 to 2014-15 were recorded.. The data was statistically analyzed by the method described by Gomez and Gomez (1984).

Fresh fruit bunch weight and yield

The FFB production/palm/year was significantly affected by the fertigation treatments over the three years (Table 1). During the year 2012-13 and 2014-15, treatment T_6 resulted in maximum number of FFBs/palm, i.e. 5.8 and 4.8, respectively. Whereas pooled mean data showed that the plants under the treatment T_5 and T_6 produced 5.2 FFBs per palm. The FFB yield obtained due to soil application of recommended dose of fertilizers (T_7) was at par with that in the treatment T_5 and T_6. This is in agreement with the results reported by Subramanian *et al*. (2012) in coconut where significantly maximum nut yield (131 nuts/palm/year) was achieved in 100% per cent NPK fertigation which was on par with 75 and 50% NPK fertigation. Similar results were reported by Bhat *et al*. (2007) in arecanut.

The effect of fertigation on FFB weight is presented in Table 2. The FFB weight was significantly different among treatments except during 2014-15. During the year 2011-12 plants under the treatment T_5 produced maximum FFB weight (26.6 kg/bunch) as compared to other treatments. However, during the years 2012-13 and 2013-14, the maximum FFB weight (24.5 kg and 25.3 kg, respectively) was recorded in plants under the treatment T_7 as compared to rest of the treatments. Over the years plants under the treatment T_5 produced significantly the maximum bunch weight (25.0 kg/bunch) which was on par with the treatment T_7.

The FFB yield data from 2005 to 2008 were treated as pre experimental data and were compared with the pooled yield mean data recorded during 2011-2014. Pre treatment FFB yield data and FFB yield data recorded during the four years and pooled mean yield from 2011-12 to 2014-15 are depicted in Table 3. The FFB yield did not differ significantly due to fertigation treatments during 2011-12 and 2012-13 but during 2013-14 and 2014-15 plants under the treatment T_5 (1.2: 0.6 : 1.8 Kg NPK/palm/year NPK through fertigation) produced the maximum FFB yield (18.3 and 18.1 t/ha, respectively). Pooled yield mean over the years also indicated that plants under the treatment T_5 produced 18.8 t/ha FFB. Plants under the treatment T_6 and T_7 produced lower FFB yield but at par with that under the treatment T_5. Greater FFB yield and monetary returns in oil palm due to fertigation @ 1.2: 0.6: 1.2 kg NPK/palm/year in six equal splits at bi-monthly interval has been reported earlier (Anonymous 2014).

For Konkan coastal zone, fertigation @ 1.2: 0.6 : 1.8 kg NPK/palm/year in equal quantity in six splits is

Table 1 Effect of fertigation on the number of fresh fruit bunch production in tenera oil palm

Treatment		No. of bunches/palm/year				
		2011-12	2012-13	2013-14	2014-15	Pooled mean
T_1	300: 150: 300 g NPK through fertigation	4.9	4.0	4.2	3.6	4.2
T_2	600: 300: 600 g NPK through fertigation	5.2	4.3	4.4	3.6	4.4
T_3	900: 450: 900 g NPK through fertigation	5.3	5.4	5.2	3.5	4.9
T_4	1200: 600:1200 g NPK through fertigation	5.9	4.7	4.7	3.0	4.6
T_5	1200: 600: 1800 g NPK through fertigation	5.9	5.1	5.2	4.5	5.2
T_6	1200: 600: 2700 g NPK through fertigation	5.8	5.8	4.2	4.8	5.2
T_7	1200: 600: 2700 g NPK through soil application	6.1	5.3	4.8	4.0	5.1
	SE ±	0.8	0.6	0.5	0.6	0.2
	CD (P=0.05)	2.4	1.8	1.6	1.7	0.6

Table 2 Effect of fertigation on fresh fruit bunch weight in tenera oil palm

Treatment		Bunch weight (kg)				Pooled mean (kg/palm)
		2011-12	2012-13	2013-14	2014-15	
T_1	300: 150: 300 g NPK through fertigation	21.9	24.2	21.7	26.4	23.6
T_2	600: 300: 600 g NPK through fertigation	20.0	21.3	18.6	23.5	20.9
T_3	900: 450: 900 g NPK through fertigation	21.0	19.6	21.1	24.6	21.6
T_4	1200: 600:1200 g NPK through fertigation	22.8	23.3	20.9	25.0	23.0
T_5	1200: 600: 1800 g NPK through fertigation	26.6	22.2	24.9	26.3	25.0
T_6	1200: 600: 2700 g NPK through fertigation	19.2	22.9	24.9	24.7	22.9
T_7	1200: 600: 2700 g NPK through soil application	21.7	24.5	25.3	25.6	24.3
	SE ±	2.2	1.3	1.6	2.0	0.8
	CD (P=0.05)	6.5	3.8	4.9	N.S.	2.3

Table 3 Effect of fertigation on the fresh fruit bunch yield of tenera oil palm

Treatment		Pre treatment mean yield (t/ha)	Yield of FFB (t/ha)				Pooled yield (t/ha)
		2005-2008	2011-12	2012- 13	2013- 14	2014-15	
T_1	300: 150: 300 g NPK through fertigation	13.9	15.1	14.0	12.9	13.9	14.0
T_2	600: 300: 600 g NPK through fertigation	14.0	15.2	13.1	11.8	12.2	13.1
T_3	900: 450: 900 g NPK through fertigation	14.4	16.0	15.2	15.8	12.2	14.8
T_4	1200: 600:1200 g NPK through fertigation	14.9	19.4	15.6	14.0	10.9	15.0
T_5	1200: 600: 1800 g NPK through fertigation	15.5	22.7	16.2	18.3	18.1	18.8
T_6	1200: 600: 2700 g NPK through fertigation	15.7	16.0	18.6	15.2	17.1	16.7
T_7	1200: 600: 2700 g NPK through soil application	16.5	18.9	18.7	17.5	14.1	17.3
	SE ±	1.2	3.2	2.4	2.0	2.2	0.8
	CD (P=0.05)	3.6	N.S.	N.S.	5.9	6.6	2.2

recommended for obtaining maximum FFB yield in oil palm.

SUMMARY

A field investigation was conducted on 18 years old tenera oil palm orchard with a view to study the effect of application of major nutrients through drip irrigation on yield of fresh fruit bunch of tener a oil palm in Konkan coastal region of Maharashtra. Six different dosage of fertilizers were applied through drip system by means of venture and compared with recommended fertilizer dose of 1.2: 0.6: 2.7 kg NPK/palm/year through soil application. The results of the pooled fresh fruit bunch (FFB) yield for four years (2011-2015) indicated that application of fertilizers @ 1.2: 0.6 : 1.8 kg NPK/palm/year through six equal splits in a year in the form of urea, diammonium phosphate (DAP) and muriate of potash (MOP) through fertigation resulted in maximum fruit bunch weight (25.0 kg/bunch), number of fresh fruit bunches (5.2 bunches/palm/year) and fresh fruit bunch yield (18.8 t/ha/year). The fertilizer dose @ 1.2: 0.6: 2.7 kg NPK/palm/year is recommended for Konkan region for achieving maximum FFB yield.

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