International Journal of Oil Palm, **3&4** : 53-56

RESEARCH PAPER

Quantification of Oil Palm Biomass at Felling

S. Sunitha and P. Thomas Varghese

National Research Centre for Oil Palm, Regional Station,
Palode-695 562, Thiruvananthapuram Dist., Kerala, India.

ABSTRACT

Oil palm is established to be one of the heavy yielders of biomass annually as well as at the end of the crop. Most often, an appropriate assessment of total biomass production of palms is based on growth performance studies, since destructive sampling is not always practical. An attempt was made to accurately estimate the biomass production of oil palm at 26 years after field planting by way of destructive sampling and weighing all the components separately. The total fresh weight ranged from 2590 to 3353 kg and the dry weight ranged from 1037 to 1360 kg. Trunk constituted more than 50% of the total biomass production. On an average about 163t/ha. of dry matter production could be expected by felling palms planted at a density of 143/ha.

Key words : Biomass production, trunk, fronds, inflorescences, spears, cabbage, roots, destructive sampling, fresh weight, dry weight.

INTRODUCTION

Among the major plantation crops, oil palm is reported to be the highest yielder of biomass. Of the total biomass production, a major share is annually available for recycling in a plantation. On an average the palm generates 20 to 25 tonnes/ha of vegetative dry matter annually in the form of fronds, bunches, male flowers and leaf bases. At the time of felling of a plantation, the available biomass include trunk, fronds, leaf bases, inflorescences, spear leaves, cabbage and the root mass. Replanting of oil palm is normally carried out after 25 to 30 years due to the difficulties in harvesting and other economic considerations. The total nutrient stocks of above ground biomass itself, at felling of old stands were reported to be 577 kg N, 50 kg P, 1255 kg K, 141 kg Mg and 285 kg Ca (Khalid *et al.*, 1999). These could be recycled in the plantation as organic matter, which in turn would reduce the fertilizer costs.

Several works were reported from Malaysia and from other countries regarding the estimation of the oil palm biomass at various ages and of old palms during replanting (Ng *et al.*, 1968; Gray, 1969; Corley *et al.*, 1971; Chan *et al.*, 1980; Tan *et al.*, 1985; Mohammad *et al.*, 1985; Mohd Hashim *et al.*, 1993 and Khalid *et al.*, 1999). Most of the previous studies were confined to the above ground biomass and excluded the significant contribution from below ground biomass. It would be accurate to include both root and shoot biomass to get an actual estimation of biomass production and nutrient contribution. In India, annual biomass production of palms at 16 years of age was estimated as15 tonnes per hectare (Varghese,1994).

An attempt was made to assess the total biomass production of oil palm at National Research Centre for Oil Palm, Regional Station, Palode, Kerala, by way of destructive sampling in an old plantation during replanting stage *i.e.,* at 26 years after planting.

MATERIALS AND METHODS

The method consisted of destructive sampling of palms and weighing all the major components, thereby directly estimating the biomass production. The area selected was a 26-year-old oil palm plantation planted in a triangular system at a spacing of 9 m. The area was divided into four blocks and palms of average height and trunk diameter were selected and one palm randomly from each block was subjected to destructive sampling.

The palms were uprooted by clearing the soil around the root mass. The shoot mass was separated from roots by cutting with a saw. The above ground mass was separated into leaflets, petiole, rachis, cabbage, spear leaves, and inflorescences trunk and leaf bases. The trunk was cut into 4 to 5 pieces of 1.5m length. The total fresh weight of each component was recorded. The coverage of adhering leaf bases in each piece of the trunk was not uniform. However, from a trunk piece having complete coverage, leaf bases were detached from the main trunk and weighed separately. Other uniform pieces were weighed and based on the proportion of leaf bases, the fresh weights of trunk and leaf bases were calculated. For other trunk portions, a few adhering leaf bases were attached to the trunk, these were detached and weighed separately.

A representative sample of each of the component *viz.,* leaflets, rachis, petiole, inflorescence, cabbage, trunk, leaf bases, spear leaves *etc.* was weighed and oven dried. From the dry weight of these samples, moisture percentages and the dry weight of the whole component parts were assessed. For the below ground portion, the whole mass was weighed. The soil in the basin was dug one foot deep all around the root mass and the loose roots were collected and weighed. The mass was longitudinally cut and a piece comprising about one-eighth portion was weighed, ridden of adhering soil by washing and again weighed and oven dried. Based on these weights, the actual biomass of each palm was estimated.

RESULTS AND DISCUSSION

The morphological observations recorded at the time of cutting palms are presented in Table 1. The height of the palms up to the tip of the latest fully opened leaf ranged between 16.3 to 20.1m and the total number of fronds ranged 37 to 45 with an average of 40. The girth of the trunk at 1.5m above ground level ranged from 46 to 67cm after removing the frond bases. The height of palms exposed the practical difficulties in handling sickles during harvesting.

The fresh weight of the component parts of sampled palms is furnished in Table 2. The total fresh weight of palms ranged from 2590 kg to 3353 kg. Tan *et al.* (1985) reported the fresh weight of a 25-year-old palm as 1934 kg with a trunk length of 7.9m and 32 number of fronds. The fresh weight of the above ground mass of 5.9m to 9.12m tall palms ranged from 1830 to 2530 kg / palm in a 23-year-old plantation (Khalid *et al.*, 1999).

The dry matter production of various palm components sampled is shown in Table 3. The total dry biomass production of palms ranged from 1037 kg to 1360 kg. The distribution of biomass in various palm components is discussed here.

Trunk : The trunk constituted more than 50 per cent of the total biomass production of palms. On an average, trunk weight at 26 years came to about 600 kg. Adhering leaf bases could also be considered as a component of the trunk. But its contribution might vary since many of

Table 1: Morphological observations of the palms sampled

Character	Palm Nos				
	1	2	3	4	Mean
Trunk height (m)	10.2	10.4	10.9	10.0	10.4
Number of leaves	37	45	42	38	40.5
Petiole length (m)	1.4	0.9	1.3	1.1	1.2
Rachis length (m)	5.25	6.95	5.65	6.00	6.0
Leaf area (m^2)	666.7	699.7	371.3	774.4	628.0
Trunk diameter (cm)	46	53	67	57	55.80

Table 2: Fresh weight of the component parts of palms sampled (kg)

Palm part	Palm nos.				
	1	2	3	4	Mean
Leaflets	135	187.4	111.5	117.5	137.8
Rachis and Petiole	305	479	320	311	353.7
Leaf bases	132	374	363	32	225.2
Trunk	1432	1815	1689	1844	1695
Spear portion	174	81.9	82	156.5	123.6
Below ground mass	412.5	416	490	400	429.6
Total	**2590.5**	**3353.3**	**3055.5**	**2861.0**	**2965**

Table 3: Dry weight of the component parts of palms sampled (kg)

Palm part	Palm nos.					
	1	2	3	4	Mean	% of total biomass
Fronds	151.7	187.1	134.6	167.6	160.2	14
Trunk	593.8	865.8	561.7	624.7	661.5	58
Spears	41.9	19.6	18.6	38.7	29.7	2.6
Below ground mass	273	287.9	323	274	289.5	25.4
Total	**1060.4**	**1360.4**	**1037.9**	**1105.0**	**1140.9**	**100**

them have started falling from the stem at that age. This component constituted only 4% of the total dry weight. Ng *et al.* (1968) reported trunk weight at 15 years as 651 kg/palm, but Corley *et al.* (1971) and Khalid *et al.* (1999) reported low value as 233 kg at 14.5-year-old palm and 302 kg for 23-year-old palm respectively. Wren (1976) reported a figure of 600 kg / trunk. At a planting density of 143 palms/ha, the total weight of palm trunk alone came to about 85.8 t at the time of felling.

Fronds: About 160 kg of frond biomass could be expected from the palms of that age. The fronds comprising leaflets, petiole and rachis portion constituted about 15% of the total biomass. Of these, two-third portion was contributed by petiole and the rest by rachis and leaflets. The biomass of leaflets ranged from 52 to 76kg per palm. Khalid *et al.* (1999) reported leaflet weight at 50 to 64 kg and petiole portion at 118 kg/palm at 23 years. An average of 22.9t/ha of frond biomass could be expected from the felled palms. Wren (1976) reported 115 kg weight of fronds with a stand of 148 palms/ha and with an 85% stand at felling to have a dry weight of 14.5 t/ha.

Spears : On an average, the palm produced 30kg dry weight of spears comprising cabbage, male flowers, spear leaves and the rest of the spear portions. This was the component least contributing to total biomass (about 2.6 %). This also agreed with earlier reports at various ages indicating that the spear mass remained more or less the same at various stages of palms, once stabilized.

Below ground biomass: The maximum quantity of roots was found between soil depths of 20 and 60cm (Hartley, 1988). The majority of primary roots remained within 1m from the soil surface and only a small percentage grew deeper (Turner and Gillbanks, 1979). In the present study, attempts were made to excavate at least 90 per cent of the root mass. On an average, a palm produced 290 kg of root biomass i.e. roots constitute more than 25 percent of total biomass. An accurate estimation of root biomass was absent in earlier reports. Gray (1969) reported the total dry weight of primary secondary and tertiary roots of 27 $^1/_2$ a year-old palm as 90.4 kg, 30.3 kg and 10.1 kg.

CONCLUSION

The average standing biomass of a 26-year-old oil palm plantation that could be expected at the time of felling was quantified by the destructive method of a few palms randomly sampled. The total biomass worked out to be about 163 t/ha on dry weight basis planted at a density of 143 palms. The trunk constituted the major share of oil palm standing biomass, which was over 50 percent of the total weight followed by those of ground biomass, fronds and spears.

The data expressed a luxurious growth put forth by this crop, especially under the humid tropical conditions of Kerala. No other plantation crop could yield this much biomass at the end of the crop. The high potential nutrient reserves of the various components could effectively be made use of by the following crop if properly managed. In the present study, a major share of the biomass was utilized for fuel purpose and the rest of the materials were for nutrient recycling in an existing plantation after composting.

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