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Palm wine and fruit yield responses of oil palm (*Elaeis guinensis*) trees to pruning frequency and season in the rain forest ecology of southern Nigeria

Abstract

Experiments were carried out between 2014 and 2017 at Iwuru oil palm plantation, Biase Cross River State Nigeria, to evaluate the effect of pruning of oil palms on yield. The experiments were laid out in a 2^3 factorial consisting of the following factors: Intensity of pruning, time of pruning and frequency of pruning. The plots were somewhat irregular in size but mostly of 20 palms. The three treatments were applied to each of nine randomized blocks. The results showed that severe pruning of palms significantly ($P<0.05$; $P<0.01$) reduced yields of oil palms such that yield values obtained from severe pruning were lower than all other values under similar experimental conditions. The differences between treatment A and B in terms of leaf pruning were not statistically significant, indicating that there was no benefit from the regular removal of dead leaves as compared with the control (no pruning except during harvest). The two best treatments were those which involved the minimum of pruning, although annual clearing was better than no pruning. The treatments affected number and size of branches. These results also showed that for Southern Nigeria Conditions, at least any pruning up to a bunch or inflorescence is likely to reduce the subsequent yields even if the leaf is one that has to be removed at the time of harvesting to gain access to the ripe bunch. These results are discussed in light of effect of pruning on oil palm in Southern Nigeria.

Keywords: pruning oil palms, fruit yield, palm wine, palm oil

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Introduction

During the early days of commercial oil palm cultivation in Southern Nigeria, it was thought desirable to prune the leaves subtending female inflorescences to allow the bunches room to develop.[1,2] This practice often led to as many as 15% of the green leaves being pruned. Doubts about the wisdom of this standard of pruning led to two experiments being laid out for this study. The results of these experiments Rutger[3] showed that any pruning in excess of cutting the leaf subtending a ripe bunch led to a reduction in yield. The experiments did not have any treatment with less severe pruning. Bunting et al.,[4] stated that the principle that pruning showed never removed more leaves in a year than are produced by the palm in a year. In another experiment, Ubi et al.,[5] favored considerably less pruning and mentioned that although only dead and withered leaves should be pruned, harvesting made it necessary that the leaf subtending a bunch should be cut at the same time as the bunch.[6,7] The authors also quoted Rutgers[1] as stating that severe pruning led to an immediate increase in yield which was then followed by a serious decline from which the palms eventually recovered. In West Africa, pruning practices have been based on regular cleaning rounds aimed at removing only the dead and dying leaves[8,9] Bunting et al.,[4] presented the chemical analyses of 20 leaves (one year's production). N – 38%; P – 6%; K – 8%. It can clearly be seen that the removal of large number of leaves from the field will bring a rapid drop in fertility of the soil. It was in consideration of these facts and the need to take a close study of pruning effect on palms of Southern Nigeria that this study was undertaken to examine the effect of some pruning experiments of oil palm in Southern Nigeria.

Materials and methods

Area 1: Leaf pruning

In order to study the effect of heavy pruning on adult palms which had been yielding since 2014 an experiment was laid out in 2017, on mature palms at Iwuru Oil Palm Plantation. The treatments were:

a. Control, no pruning, except for harvesting
b. Light pruning – dead leaves removed continuously
c. Severe pruning – all leaves except those of the central spear removal.

Treatment C was performed once, in July 2017. The plots were somehow irregular in size but mostly of 20 palms. The three treatments were applied to each of nine randomized blocks.

Area 2: Pruning experiment

This experiment was designed to test the effects of the pruning methods practiced at Iwuru, Biase, Cross River State Nigeria, upon the yields of the palms. The treatment started in July, 2014 after four years of pre-treatment yields had been obtained. The four treatments were:

a. No pruning except for harvesting
b. Plantation pruning – dead and dying leaves pruned twice a year
c. Iwuru pruning – pruning up to a bunch, if no bunch prune to five youngest leaves; if the palm is in a male cycle, the male inflorescence to be tapped immediately after pruning.
d. Severe pruning – pruning to central spear.

Treatment B was pruned in December/January and June/July each year, treatment C pruned once a year in December/January and treatment D on three occasions, December 2014, January 2015, and January 2017. It was feared that with more frequent pruning of treatment D, the loss in yield would be too great.

The plots consisted of 12 palms and the treatments were randomized in twelve blocks.

Area 3: Plantation pruning experiment

The experiment was started in January 2014 and pre-treatment yields were available for the period 2014 to 2017. The treatments were:

a. No pruning except for harvesting
b. Annual cleaning – removal of dead leaves and ferns
c. Pruning up to a bunch every 9 months
d. Pruning up to inflorescence at the stage of anthesis. Plots contained 9 palms and there were twenty five blocks.

Area 4: Pruning experiment

This experiment was started in April 2014 and was designed to test the effects not only of intensity of pruning, but of frequency and season of pruning. The treatments were laid out as a factorial experiment, the factors were:

i. Intensity of pruning
  a) Pruning to an open
  b) Severe pruning
ii. Time of pruning
  a) Beginning of rains
  b) End of rains
iii. Frequency of pruning
  a) Annually
  b) Every two years

Plots contained eight palms and the 2^3design was confounded so that the plots were arranged in eight blocks of four plots. The blocks were allocated to the plots on the basis of 2014–2017 pre-treatment yields.

Replanting experiment

Although not a pruning experiment, this experiment contained one treatment which consisted of palms being replanted under the old stand of palms. The old palms had half of their leaves pruned at the time replanting and again in the following October. They were further pruned to the spear in the following April and felled a year later. There was no control for this treatment which started in April of that year. The yields before and after pruning were recorded and compared with the yields from nearby untreated palms.

Statistical analysis: Data was subjected to analysis of variance (ANOVA) and means compared using Fischer's Least Significant Difference (LSD) at 5% probability level, (Wahau 1999).

Results

The results of leaf pruning experiment (Area1), on the yield of fresh fruit bunches, FFB (t/ha^{-1}) is presented in Table 1.

Table 1 Average yield of fresh fruit bunches (FFB) t/ha^{-1}

Period	Control	Light pruning	Severe pruning
Pre-treatment	FFB (t/ha^{-1})	FFB (t/ha^{-1})	FFB (t/ha^{-1})
2014	5.0	8.5	0.5
2015	9.1	3.4	5.0
2016	3.2	5.2	3.2
2017	7.0	2.5	1.1
2018	3.0	3.0	1.5
Level of statistical significance	P<0.001	P<0.001	P<0.001

Area 1: Leaf pruning

Statistical analysis of covariance of the 2014 and 2017 yields on pre-treatment yields showed that values of treatment B were significantly (P<0.001) higher than all other values under similar experimental conditions. The yields of 2014 and values of 2015 were not significantly different (P<0.05; P<0.001) (Table 1).

The palms pruned severely in July 2016 (treatment C) recovered rapidly and within six months were not visibly different from the palms in the other treatments. It was concluded that the severe pruning led to a fall in yield within eighteen months of pruning, the fall was about 50% of the yield from the control. The drop in yield was largely caused by a 60% reduction in the number of bunches (p<0.001) and many of the palms in treatment C failed to yield in 2016. The results of 2017 corrected for pre-treatment yield are presented below: Table 2.

Table 2 Yield per palm in 2017 corrected yield

Treatments	No of bunches per palm	Average bunch weight per palm (kg)	Total weight of bunches per palm (kg)
A. Control	3.4	12.5	50.2
B. Light Pruning	3.1	12.2	48.6
C. Severe Pruning	2.3	11.5	21.4
Level of statistical significance	P<0.001	N.S.	P<0.001

The difference between treatment A and B were not statistically significant (p<0.001) which means that there was no benefit from the regular removal of dead leaves as compared with the control. (No pruning except during harvesting)

Area 3: Pruning experiment

A part from the yields which were recorded on all treatments, the number of leaves cut from the Area 2 and severe pruning treatments (C and D) were recorded.

The average number of leaves pruned from each palm over and above those pruned during harvesting are given below: Table 3.

It is of interest to note that when the palms in treatment C were in a male phase, the inflorescences were tapped for wine. The number of palms tapped and quantity of wine obtained is given below Table 4.

Table 3 Average number of leaves per palm

Date of pruning	Treatment C Iwuru method	Treatment D severe pruning
January 2011	Not known	Not known
January 2012	15.2	20.6
January 2013	16.4	26.5
January 2014	17.5	30.4
January 2015	14.3	34.2
January 2016	18.5	-
January 2017	15.4	-
January 2018	16.3	-

Table 4 Production of palm wine (litres) from palms in treatment C

Date of tapping	Number of palms in male phase	Average quantity of wine/palm (litres)
January 2011	25	1.4
January 2012	21	2.5
January 2013	12	3.2
January 2014	33	2.1
January 2015	21	8.5
January 2016	38	3.4
January 2017	25	2.7
January 2018	23	3.5

The result in Table 4 above showed that the number of litres of palm wine was not influenced by the palm population but rather on the year and date of tapping. Thus there was 507.14% increase 8.5 – 1.4 = (7.1/1.4X 100), comparing the value of 2014 with that of 2017 in terms of average palm wine per palm (Table 5).

Least significant difference

P<0.05	15	514
P<0.01	20	630
P<0.001	26	851

Table 5 Adjusted mean yield per hectare per annum 2012 to 2018

Treatment	Number of bunches	Weight of bunches (kg)	Weight per bunch (kg)
20.85	A. No pruning	165	3,778
26.89	B. Plantation pruning	153	3,765
30.76	C. Iwuru pruning	120	2,653
28.62	D. Severe pruning	112	2,436

The two treatment involving severe pruning treatments C and D greatly reduced both the number and weight of bunches. The yearly variation of these yields and their relation to the pruning treatment are well expressed. From the above data, severe pruning tended to lower the number of bunches weight of bunches and weight per bunch throughout the study period, the values are significantly (P<0.05; P<0.001) lower than all other values under similar experimental conditions (Table 6).

Least significant difference

P<0.05	10	362
P<0.01	12	384
P<0.001	16	619

Table 6 Plantation Pruning Experiment, Adjusted mean yield per hectare per year

Treatment	No of bunches	Weight of bunches (kg)	Weight per bunch (kg)
A. No pruning	334	7,451	25.1
B. Annual cleaning	325	7,658	26.3
C. 6 – monthly pruning	288	6,742	22.6
D. Pruning to an open inflorescence	279	6,133	22.5

From the above results (Table 6), annual cleaning tended to be favoured by more number of bunches, weight of bunches and weight per bunch, throughout the study period. There was a 20.29% (335 – 279 = 56/276 X 100%) unit increase in number of bunches and 21.49% unit increase 76.58 – 61.33 (13.18/61.33X 100%) in weight of bunches which was significantly (P<0.05 and P<0.1) higher in annual cleaning than pruning to an open inflorescence given similar experimental conditions. Thus the two best treatments were those which involved the maximum of pruning, although annual cleaning was better than no pruning. The treatments affected both number and size of the bunches similarly (Table 6).

Pruning experiment

The mean yield of pruning experiment (kg/ha^{-1}) per year are presented in Table 7:

Least significant difference

P<0.05	42	7,67
P<0.01	-	1,132
P<0.001	-	1,406

From the results in Table 7, pruning to an open inflorescence recorded the highest value of weight of bunches 6,537 kg while the lowest value (5,017 kg) was recorded from pruning to the central spear. These results were significant (P<0.05; P<0.01). The treatment aid not significantly affect the number of bunches. Time of pruning had no significant effect, but pruning every two years led to more yield than annual pruning (Table 7). None of the interactions was statistically significant. The reduction in yield from more severe or more frequent pruning has come from a reduction in both the number of bunches and the weight per bunch.

Table 7 Mean Yield (t/ha^{-1}) of Pruning Experiment

Treatment	No of bunches	Weight of bunches (kg)	Weight per bunch (kg)
A_o Pruning to an open inflorescence	285	6,637	27.12
A_1 Pruning to the central spear	256	5,017	21.07
B_o Pruning at the beginning of rains	261	5,667	22.01
B_1 Pruning at the end of rains	273	5,867	22.18
C_o Annual pruning	248	5,343	22.1
C_1 Pruning every two years	285	6,315	22.14

Discussion

In all the experiments studied, it has been demonstrated that the removal of any green leaves reduced yield, both in terms of the number and the total weight of bunches. These results shows that for Southern Nigeria conditions at least any pruning up to a bunch or inflorescence is likely to reduce the subsequent yields, even if the leaf is one that has to be removed at the time of harvesting to gain access to the ripe bunch. In plantation pruning, there was a significant greater yield from the annual cleaning treatment than from the control treatment. As the increase was both in number and weight of bunches the effect is difficult to explain unless the removal of dead dying leaves and epiphytes increases the efficiency of pollination.

The fact that the mean bunch weight has increased shows that the effect may not have resulted solely from the more efficient harvesting. The results of the treatment on replanting experiment is evidenced to support assertion that the immediate effect of pruning is to increase the yield followed by a decline in yield subsequently. It is possible that following severe pruning, nutrients which normally pass to the leaves, pass instead to the developing bunches. Once the female inflorescence already formed at the time of pruning have ripened, the decrease on leaf area and hence photosynthetic area leads to the palms passing to a predominantly male cycle with a consequent drop in yields. One beneficial effect that pruning can have on the surrounding palms is described by Sparnaaij, (1990). He showed that severe pruning of the surrounding palms led to an increased yield in the untreated palms, the increase being attributed mainly to the increase light reaching the palm. Obviously, this observation does not apply to plantation palms where all palms are likely to have the same level of pruning, but it could apply to dense stands in palm groves where the severe pruning of some palms to provide leaves and palm wine should lead to increased yields of fruit bunches from any adjacent untreated palms.

The removal of epiphytes in these experiments was linked with the pruning of the leaves.[11] However, there is no reason to believe that young palms would respond to the pruning treatment differently from the old palms. Some degree of pruning of badly diseased leaves may be necessary on young palms during their first two years in field and this is being investigated further. It is worthy to note that it is not advisable technically to remove any green leaves harvesting from the age of two years until about ten years, provided suitable tools are used for harvesting.[12]

Conclusion

The economy of palm wine production from palm trees through controlled and timely pruning was exposed in this study and the results also showed that for Southern Nigeria Conditions, at least any pruning up to a bunch or inflorescence is likely to reduce the subsequent yields even if the leaf is one that has to be removed at the time of harvesting to gain access to the ripe bunch. These results are discussed in light of effect of pruning on oil palm in Southern Nigeria.

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Competing interest

The authors declare that there are no competing interests in this manuscript.

Authors contribution

All authors contributed immensely in the development of this manuscript from the design, writing of manuscript sections, statistical analysis, proof reading/editing and financial contribution.

References

1. Rutgers AL. Production cutters of oil palms. Announcements from the General Protestation of the AVRO. 1982. p. 30.
2. Ubi W, Omaliko CPE. Influence of Age and Time of Transplanting on the number of leaves produced leaf production interval of oil palm seedlings transplanted into the field. *Nigerian Southern Journal of Agriculture Economics and Extension*. 2003;5(1):10–18.
3. Rutgers AAL. Investigations on oil palms: Experiment station AVRO. 1978. p. 125.
4. Bunting B, Eaton BJ, Georgi CDV. *The oil palm in Malaya*. Malaya: Kanle Lampur; 1989. p. 293.
5. Ubi W, Iqwe H, Ekpe S. A comparative study of Zero tillage bulldozing as land preparations for oil palm growth and Nutrient Status after 5 years planting. *Global Journal of Agricultural Sciences*. 2005a;4(2):49–154.
6. Sparnaai JLD. The analysis of bunch production in the oil palm. *Journal of West Africa Institute for oil palm Research*. 1969;3:9–180.
7. Ubi W, Igwe H. Preliminary study of zero tillage and bulldozing as land preparations for oil palm growth and Nutrient Status after 8 years of field planting. *Global Journal of Environmental Sciences*. 2005b;4(2):63–67.
8. Anon N. The maintenance of palm groves. Ole'a gineux. 1962;17:777–781.
9. Surre C, Zillar R. Lepalmier a'huile. Paris.1963. p. 243.
10. Ubi W. Effect of Age and Time of transplanting on leaf Area (LA), Specific leaf Area (SLA) and leaf longevity of poly bag oil palm seedlings transplanted into the field. *Global Journal of Environmental Sciences*. 2004;3(1):71–74.
11. Greig JL. Epiphytes on oil palms. *Malaysia Agricultural Journal*. 1977;25:448–452.
12. Sly JMA. The results from pruning experiments on adult oil palms in Nigeria. *Journal of the Nigerian institute for oil palm research*. 1968;5(17):89–99.