Original Research Article

RESIDUAL EFFECT OF INTERCROPPING OIL PALM WITH FOOD CROPS ON YIELD OF THE OIL PALM

Abstract

The oil palm industry in Ghana is dominated by small scale farmers who normally intercrop oil palm with food crops (maize, cassava and plantain). A trial was conducted on a four year old oil palm field which had been intercropped with food crops for three years (1994-1997). Observations were carried out on the field from 1997-2007to find out the residual effect of the intercrop on the yield of oil palm. The field was compared with the standard system of cover cropping oil palm with Pueraria sp. The experiment was laid out in a randomised complete block design with 4 treatments and four replications. Each plot measured 35.2 x 22.7 m and had 12 palms. Vegetative and yield data were collected on the palms. There were no significant differences between the vegetative and yield data of the fields that were intercropped and sole cropped. Intercropping oil palm with maize, plantain and or cassava had no adverse effect on the growth, development and yield of the oil palm.

Keywords: oil palm, intercropping, food crops, yield

1.0 INTRODUCTION

Oil palm (*Elaeis ginnensis* Jacq.) cultivation in Ghana is dominated by small scale farmers who occupy about 70% of the estimated total area of 145,500 hectares under oil palm cultivation (Anonymous, 1990, Anonymous, 1989). The remaining 30% of the oil palm production area is under cultivation by development state and their affiliated small scale out-growers who practice monocropping. The development estates under plant the oil palm with *Pueraria sp*, a leguminous cover crop which is expected to suppress weed growth, control erosion, conserve soil moisture and ultimately improves fertility by fixing atmospheric nitrogen.

The standard 8.8 m triangular spacing use for oil palm provides wide spaces between the young palms. This leads to considerable waste of solar radiation and weed problem from transplanting to canopy closure which takes between three to five years, (Chee *et al.*, 1992).

Leguminous cover, *Pueraria sp* has a number of benefits; however small scale farmers do not plant them under their oil palm. They instead intercrop the oil palm with food and other cash crops for three to four years before the canopy closes. Some even remove fronds to make way for space to intercrop food crops Nuertey *et al*., (1998).

Farmers may seem justified then by growing food and/or cash crops between oil palm trees until canopy closure. Nuertey *et al*., (1998) identified a number of crops that the farmers intercrop with oil palm and the basis of their selection.

There is no information on the effect of the intercropping on the yield of oil palm after the intercropping is over and the oil palm takes full stand.

The objective of this study was:

To assess the performance and yield of the oil palm which had been intercropped with food crops for three to four years.

2.0 Materials and Methods

The trial was conducted on a field which had been intercropped from 1994 through to 1997 at the Oil Palm Research Institute (OPRI), Kusi. The experiment was conducted in a randomised complete block design with 4 treatments and four replications. Each plot measured 35.2 x 22.7 m and had 12 palm seedlings. Planting was done at a spacing of 8.8 m triangular or the equivalent of 148 palms per hectare. The following crops were intercropped with oil palm seedlings transplanted in April 1994 and constituted treatments.

i. Oil palm + pueraria: oil palm interrows were cultivated with a leguminous cover crop, Pueraria phaseoloides. The cover crop was seeded at 0.5 kg per plot in 1994 after transplanting the seedlings. This is the standard estate practice and served as control in this experiment.
ii. Oil palm + maize + cassava: oil palm interrows were intercropped with maize and cassava during the major season. The maize (var. Okomasa ex CRI) was planted in April 1994 at a planting distance of 0.7 x 0.5m with three plants per stand but thinned

to two plants one week after emergence resulting in a plant population of 3780 per plot. The cassava, a mixture of Nzema, bosome Nsia and Ankra was planted in may 1994, two weeks after the emergence of maize and spaced at 1m within rows giving 945 plants per plot. The maize was harvested four months after planting while the cassava was harvested 10 months after planting. The cycle was repeated till 1997, after which the sited was adopted for this experiment.

iii. Oil palm + maize + plantain: the palm interrows were intercropped with maize and plantain during the major season in 1994. The maize was planted and harvested in the same manner and time as in the previous treatment and at the same planting density. The plantain, false horn variety, 'Apantu pa' was planted at 3 m triangular in the interrows of the oil palm thus giving 88 plantains per plot. The nearest plantain row with reference to the oil palm row was 1.2 m equidistant away from the oil palm rows. After the havesting of maize, the plantain was maintained up to the end of first ratoon of the crop that is January 1997.

iv. Oil palm + maize + maize: oil palm interrows were intercropped with maize in the major season and followed by maize in the minor season. The major season maize was planted in April and harvested in August as in treatment (ii). The minor season maize was planted in September 1994 and was harvested in December that same year. The spacing and plant population for both the major and minor season were the same as in treatment (ii). The cycle was repeated every year for three years.

The field was weeded two times in a season. The leguminous plots in treatment 1 were slashed and a circle of 1m around the palm was clean-weeded every three months. Plantain was mulched with chopped dried weeds at the pre-harvesting period. The pseudostem and leaves were used for mulching after harvesting. Fertilizer was applied to oil palm seedlings six months after transplanting and thereafter, in September every year. Nitrogen was applied at 42g, P at 48g and K at 250g per tree (Anom, 1988). No fertilizer was applied to the food crops (maize, cassava and plantain).

2.1 Data Collection

2.1.1 Agronomic analysis

Leaf area (LA), Leaf area index (LAI) and frond dry weight were taken once every year. These parameters were determined from the relationships below;

1. LA was computed using the equation by Harden *et al.,* (1969).

   $$LA = b(n * LW)$$

   Where:

   n= number of leaflets, LW= mean of length x mid-width for a sample of the largest leaflets, and b = correction factor = 0.55

2. $\text{LAI} = \frac{\text{leaf area}}{\text{Ground area}}$

3. FDW was obtained using formula developed by Corley 1971. The width and depth of the petiole of the frond number 17 were measured with callipers and values obtained were put a formula to estimate the Frond Dry Weight (FDW).

   FDW= 0.11026*W*D + 0.2362 (kg)

   Where W= width of the petiole of frond 17

   D= depth of the petiole of frond 17

4. The plant height was measured with graduated measuring pole from the base (ground level) of the palm to the point of insertion of leaf number 33.
5. Yield of oil palm

Weekly individual yield recording was carried out soon after the palm came into bearing. The weights and number of the fresh fruit bunches (FFB) harvested were recorded for individual palms at each harvesting round. The data obtained was used to estimate yield per hectare. The data obtained was analysed with GENSTAT 2012.

Results

Figure 1. shows the residual effect on palm height. Differences in height were observed among the treatments. The Op + Ma + Ma recorded the highest plant height, followed by Op + Pue. The height were in the order Op + Ma + Ma > OP + Pue > OP + Ma +Ca > OP +Ma +

Pl except on the 8th year after transplanting that the order changed. In that year alone, the order was OP + Pue > OP + Ma + Pl > Op + Ma + Ma > OP + Ma + Ca. The height of the treatments did not vary significantly for all the periods of the trial.

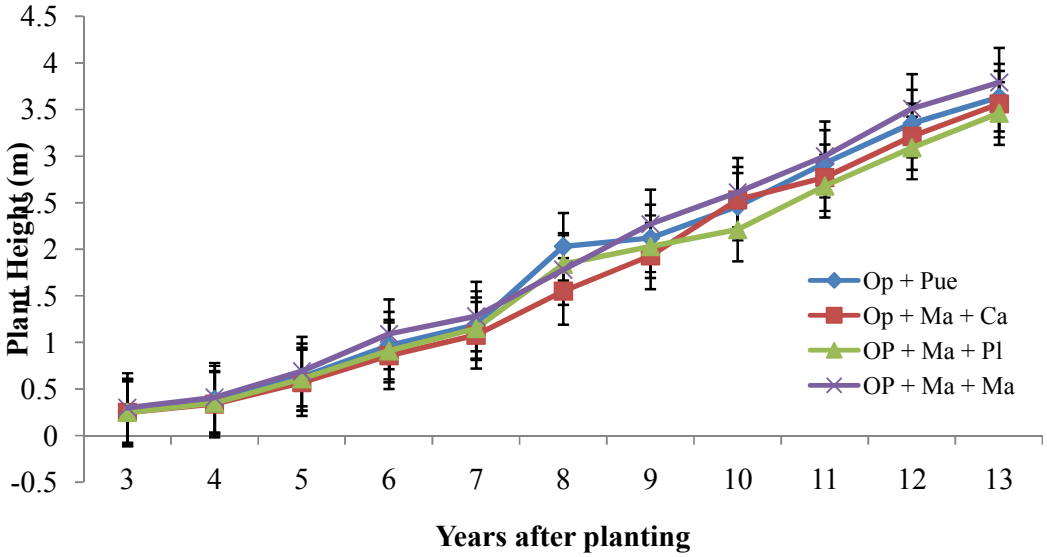

Fig. 1. Effect of food crops intercrop on the height of oil palm

Figure 2 shows the accumulation of frond dry weight from the year 1997 to 2007. In general, frond dry weight increased with age during the experimental period. The frond dry weight three years after planting was in the order OP + Ma + Pl > Op + Ma + Ma > OP + Pue > OP + Ma + Ca. There was no significant difference ($P \leq 0.05$) between the treatments. However, in most of the years, the order was Op + Ma + Ma > OP + Ma + Pl > OP + Pue > OP + Ma + Ca.

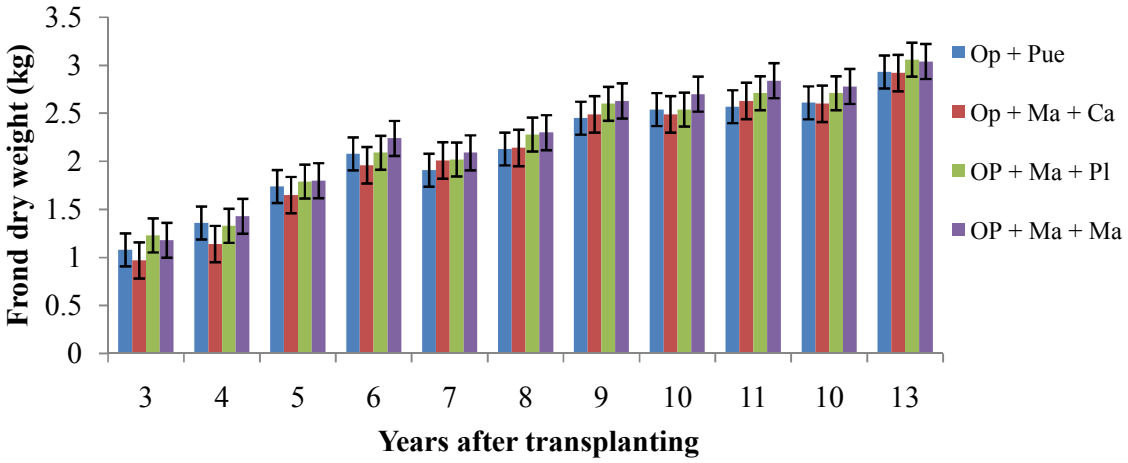

Fig. 2. Effect of food crops intercrop on palm dry matter accummulation

The leaf area and leaf area index showed a linear increase with increase in age (fig. 3 and 4). There were no significant differences ($P<0.05$) between the treatments. In few occasions that Oil Palm + Pueraria performed better than the other treatments, leaf area of this treatment was lower in most of the occasions. From 8 to 12 years after planting, oil palm and maize plus maize intercrop produced relatively larger leaf area than the other treatment. At the 5th and 7th year after planting, oil Palm plus maize and plantain had largest LA. The leaf area index (LAI) increased with increasing palm age (fig.4). However it was not significantly different from the other treatments. This was followed by May transplants for years 2001 and 2002. From 2004 to 2005, September transplant recorded LAI which was higher than that of May but lower than that of July. November transplants recorded the lowest LAI in 2004 and 2005.

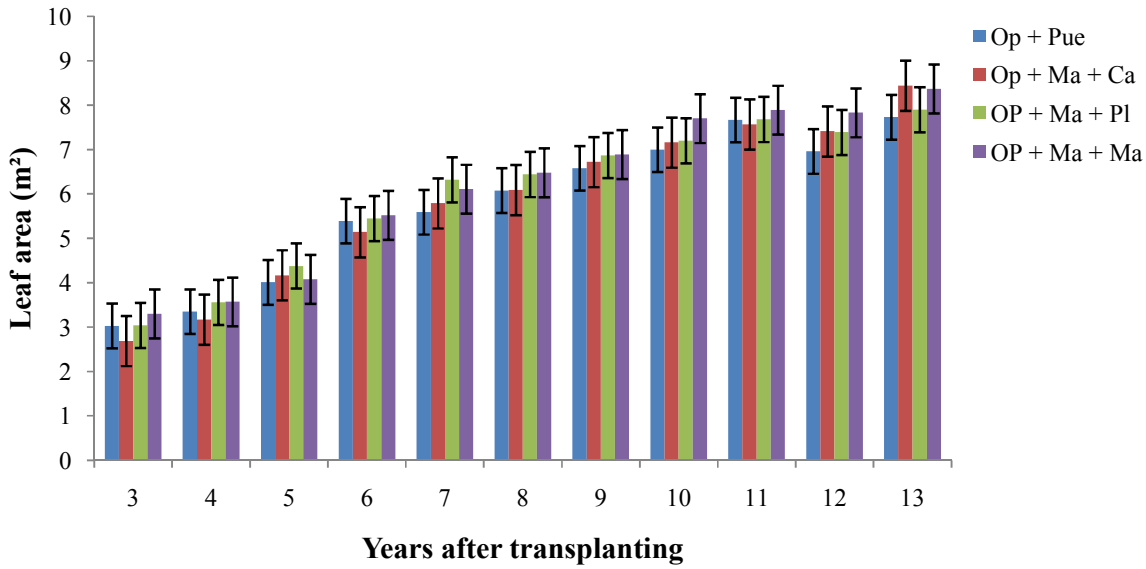

Fig. 3. Effect of intercropping oil palm with food crops on Leaf area of oil palm

141

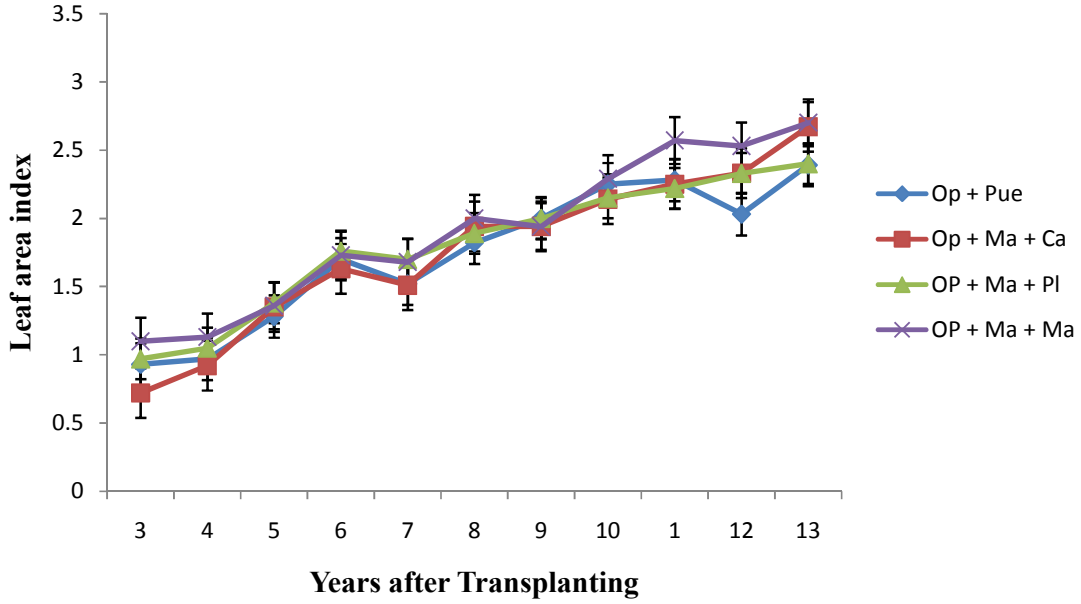

Fig. 4. Effect of intercropping on LAI of oil palm

142

143

144

145 **Yield and yield components**

146 There were no significant differences between the yields of oil palms planted at the same year
147 (fig. 7). There was an increase in bunch weight with palm age (fig. 5). From the 4th to 10th
148 year after transplanting, OP + Ma + Pl recorded relatively high single bunch weight than the
149 other intercrops. This was followed by OP + Ma + Ca. In that same period, Op + Pue and Op
150 + Ma + Ma recorded the lowest single bunch weight. On the 11th and 13th year, all the four
151 treatments recorded almost the same value for the single bunch weight, but on the 12th year,
152 the trend was op + Ma + Pl>Op + Pue >OP + Ma +Ca >Op + Ma + Ma.

153

154

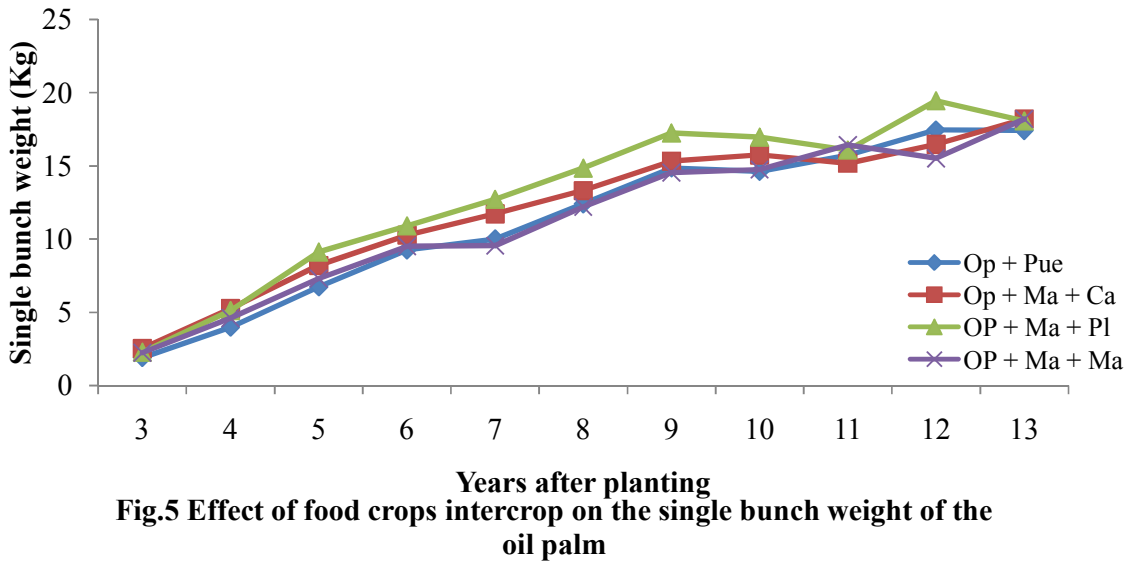

Fig.5 Effect of food crops intercrop on the single bunch weight of the oil palm

155

156 The effect of intercropping on the number of bunches per palm per year is shown in figure 6.
157 The number of bunches per palm per year increased initially and decreased with age. The
158 yield became somewhat stable at 10 and 13 years stage with mean values around 4.0 – 6.0
159 bunches/palm/year. There were no significant differences between the numbers of bunch of
160 the palms of the same year.

161

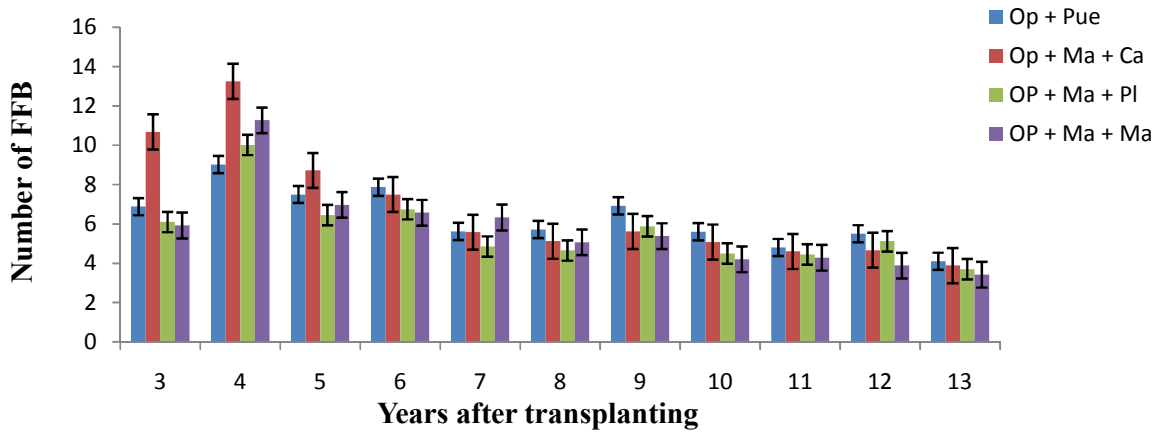

Fig. 6. Effect of food crops intercrop on the Number of bunches/palm/year

162

163

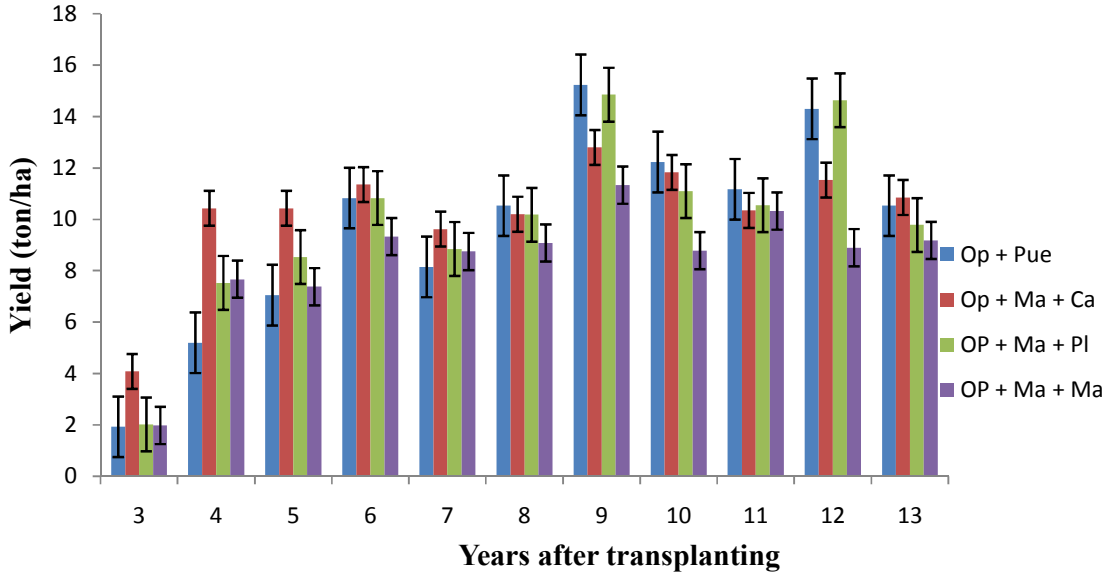

Fig.7. Effect of food crops intercropped with oil palm on the yield of oil palm

164

165

166

167

168

DISCUSSION

Growth and yield of oil palm field intercropped with food crops

It is very difficult to do away with intercropping food crops with oil palm especially among the small scale oil palm farmers. Nuertey *et al* (2000) indicated that it is profitable to intercrop oil palm with food crops especially for the first three to four years when the palms are not fruiting as compared to sole cropping. It is therefore important to educate farmers on the proper way to do this intercropping.

The results from this study also indicated that there is no adverse residual effect on the growth, development and yield of the oil palm fields which were previously intercropped with food crops. This suggests that the intercrops did not adsorb excessive nutrient from the field that will affect the nutrient requirements of the palms.

The differences in the growth and yield of oil palm were apparently strongly in the first three years after the intercropping. These could be attributed to the decomposition of crops residues after harvesting. Moreover the regular weeding of intercropped field and its eventual decomposition of weeds might have had added advantage to the growth of oil palm even though that was not significant. Despite the numerous advantages of the *Pueraria* cover crop there may be competition between the *Pueraria* cover crop (leguminous cover) and the oil palm as had been pointed out by Hartley, 1988. There is therefore the need to quantify the competition effect on oil palm with other plants association whether cover crop or food crops.

As pointed out earlier by research by Nuretey *et al* 2000, that it is profitable to intercrop oil palm with food crops especially for the first three to four years when the palms are not fruiting as compared to sole cropping. Farmers are able to get enough money from the intercrop to sustain their family and also to maintain the farm. Sparnaaij 1957 also pointed out that there is no adverse effect of early inter-cropping oil palm with maize, cassava and plantain.

CONCLUSION

Intercropping food crops with oil palm has no adverse effect on the development and yields of the oil palm; it is therefore advisable for farmers to intercrop oil palm with food crops. Estates developers on the other can allow intercropping in their fields especially for first one to four years after planting to their workers.

References

Anon. (1989). Repoprt of the FAO/world bank cooperative programme: A study for Ghana.

Anon. (1990). Commissioned report of the Ghana oil palm development association (GOPDA) on oil palm industry in Ghana.

Corley, R. H. V. (1971). Analysis of growth and the oil palm (Elaeis guineensis Jacq) 1. Estimation of growth parameters and application. Bree ex. T. Euphtica. Corley, R. H. V.

Chee Y. K., Ahmadraiz, A. And Chung, G. F. (1992). Managment of weeds in plantation crops 2000. In preceeding of pest management and the environmental in 2000. Chapter 19 pp iii-vii, 1-401.

GENSTAT 2012. Discovery edition.

Nuertey B.N., Ofori K., Doku E. V. And Wonkyi Appiah (1998). A survey of oil palm based cropping systems in Ghana, paper presented at the first biennial National Agricultural Research systems (NARS) workshop, 16-20th Nov. 1998, Accra.

Nuertey B. N., Ofori K. And Asamoah T. E. O., (2000). Economics of intercropping food crops in oil palm for small scale farmers. Journal of the Ghana Science Association. Vol.2 No. 3, 170-176

Harden, J.J., Williams, C.N. and Watson I. (1969). Leaf area and yield in oil palm in Malaysia. Expl Agric 5:25-32

Nuertey B. N., Ofori, K., Doku, E. V. and Wonkyi-Appiah, J.B. (1998). A survey of oil palm based cropping systems in Ghana, A paper presented at the 1st Biennial National Agricultural research systems workshop, 16-20 November 1998, Accra, Ghana.