

RESPONSE OF COCONUT AND COFFEE TO FERTILIZERS APPLIED ON EITHER OR BOTH CROPS IN AN INTERCROPPING SYSTEM

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A study to assess the effects of fertilizer application on either coconut or coffee or both in an intercropping system was conducted from 1985 to 1992.

Fertilizer application on coconut with or without coffee fertilization increased copra yield significantly. Unfertilized coconut even if coffee was fertilized produced low yield suggesting that coconut could not benefit from the fertilizers applied on coffee.

Likewise, bean yield of fertilized coffee was increased significantly regardless of whether the coconut was fertilized or not. Otherwise, even if coconut was fertilized, the coffee yield did not increase suggesting that coffee did not benefit from the fertilizer applied on the coconut. Hence, there is a need to apply fertilizer separately to both crops.

Economic analysis revealed that fertilizer application to both coconut and coffee gave the highest net return followed by treatment where coffee alone was fertilized.

INTRODUCTION

Observations show that most of the small-scale some large-scale farmers who practice intercropping apply fertilizers only on the intercrop. In other countries like Tanzania and Fiji, fertilizer application on intercrops is a common practice.

This practice is resorted to especially when the price of copra is very low while that of inputs are high. However, there is a need to compromise between the farmers' desire to lower farm expense and the country's need to maintain the trade position of Philippine coconuts in the world market, and thereby earn more dollars in the process.

In intercropping systems involving coconut, there are no reported cases where fertilizer applied only to one crop would benefit the other crop. Results of earlier studies at the

Philippine Coconut Authority however, show that where both coconut and intercrops were fertilized, the yield of coconut in a multi-storey cropping pattern with three intercrop combinations significantly increased (Margate and Magat 1983). Felizardo (1983) suggested that there should be separate fertilization program for both coconut and the intercrop based on their individual recommendations or as if they are not planted in the same area.

This study was conducted to know whether the fertilizer applied on the coconut would benefit the coffee intercrops or vice versa.

MATERIALS AND METHODS

Experimental palms/area

About 25-30 yr old 'Laguna' tall palms, distanced 8 x 8 m square were used in the study. The palms were planted in a Tugbok clay loam soil (Alfisol) on a generally flat and well-drained area. The palms were fertilized

yearly (for those treatments requiring fertilizer) with 1.5 kg Ammonium sulfate + 1.6 kg Potassium chloride (KCl). However, prior to this experiment the palms used were uniformly fertilized.

Intercrop

Robusta coffee was used as intercrop because of its wide acceptance by farmers. Plastic-bagged seedlings were acquired from the Bureau of Plant Industry, Davao City. They were planted in two rows in between coconut rows in a triangular pattern. For those requiring fertilizers, coffee intercrops were fertilized with 14-14-14 in the first two years at the rate of 200 and 250 g/tree/yr, respectively. The amount was increased by 50 g/yr until the fifth year. Thereafter, ammonium sulfate was used at 600 g/tree as the coffee trees showed inadequate levels of nitrogen (N) and sulfur (S).

Treatments

The treatments were as follows:

- T1 - coconut unfertilized + coffee unfertilized
- T2 - coconut unfertilized + coffee fertilized
- T3 - coconut fertilized + coffee unfertilized
- T4 - coconut fertilized + coffee fertilized

Experimental Design

The above treatments were arranged in a randomized complete block design in 3 replications. The experimental unit was composed of 9 palms/plot completely surrounded by 48 coffee trees.

Data Gathered

For coconuts, data gathered were: number of nuts/tree/year, copra weight/nut, copra/palm/year, and yearly leaf analysis.

For coffee, the following were taken: yield data, number of lateral branches, and number of leaves of two opposite lateral median branches. Leaf analysis was done yearly while soil analysis was conducted at the end of the study.

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Simple cost-benefit analysis was made for the final year of production.

RESULTS AND DISCUSSION

Coconut Production

Nut production of palms did not differ significantly among treatments in all the years of observation (Fig. 1). Further addition of fertilizer did not bring about a substantial increase in the number of nuts as this was already high even in the control plots.

More apparent response was noted on copra weight/nut (Fig. 2) which started in the second year of observation. The weight of copra/nut was low in unfertilized palms whether the coffee intercrop was fertilized or not. This indicates that coconut generally did not benefit from the fertilizer applied on the coffee intercrop. On the other hand, fertilized coconut gave higher copra production/nut regardless of whether coffee was fertilized or not.

On copra weight/palm/yr (Fig. 3) the same trend of response was observed as in copra weight/nut. Where fertilizers were applied on coconut, with or without coffee fertilization, copra yield/tree increased significantly over the unfertilized ones. This was consistent over the years and was also observed on the 7-yr. average yield. On the other hand, copra yield/tree of Treatment 2 (unfertilized coconut + fertilized coffee) did not differ significantly from the control indicating again that coconut had not benefitted from the fertilizers applied on coffee intercrop. This suggests separate fertilization for both crops.

Growth and Yield of Coffee

More coffee trees from the unfertilized plots died during the first two years due to nutritional problems (Fig. 4). With their limited root system, the coffee plants could not intercept the fertilizers applied on coconut. In fact, the remaining plants had to be supplied with minimal amount of fertilizers to let them recover and survive.

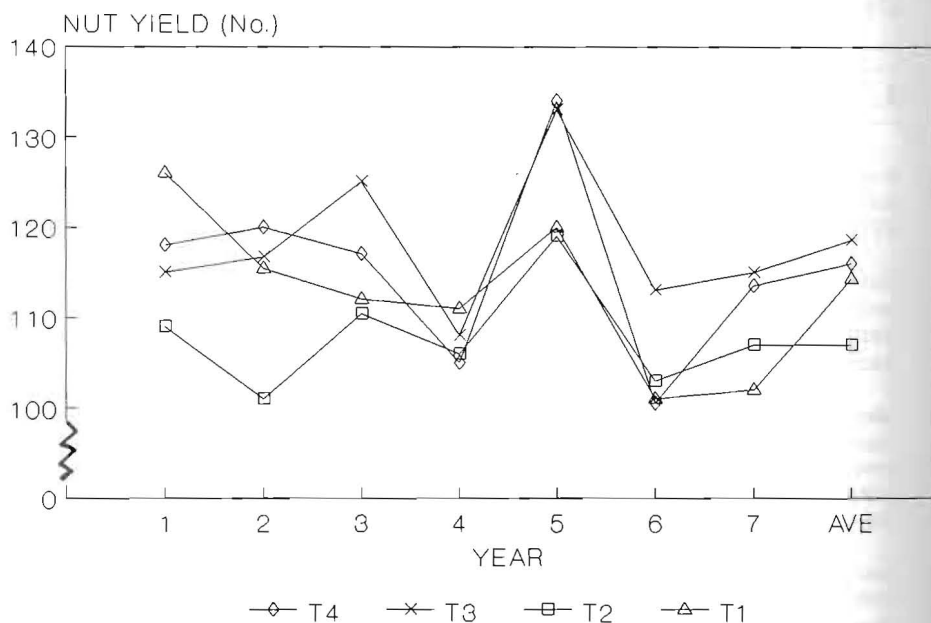


FIGURE 1
Nut production of palms in relation to various treatments

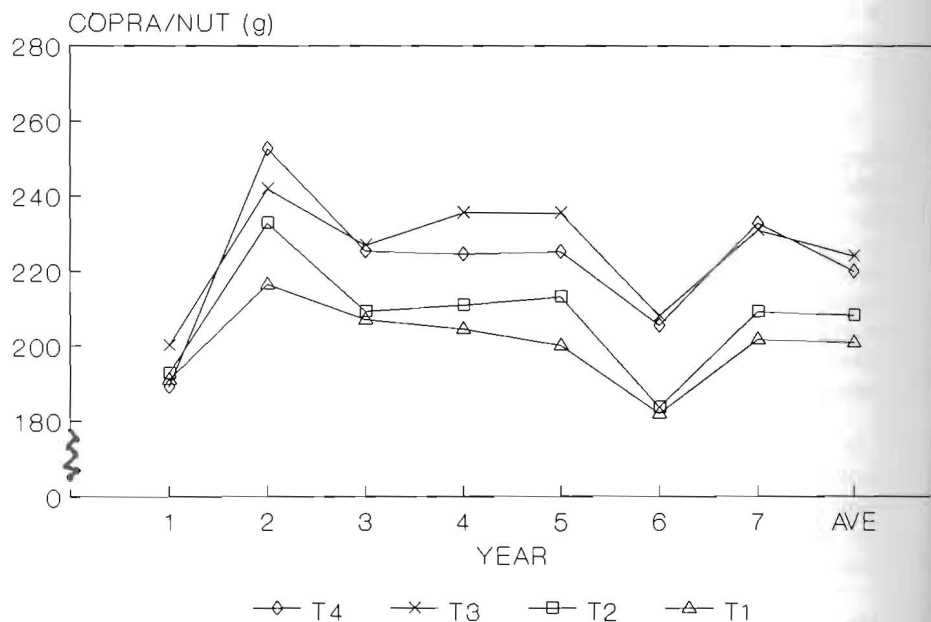


FIGURE 2
Copra production per nut in relation to various treatments

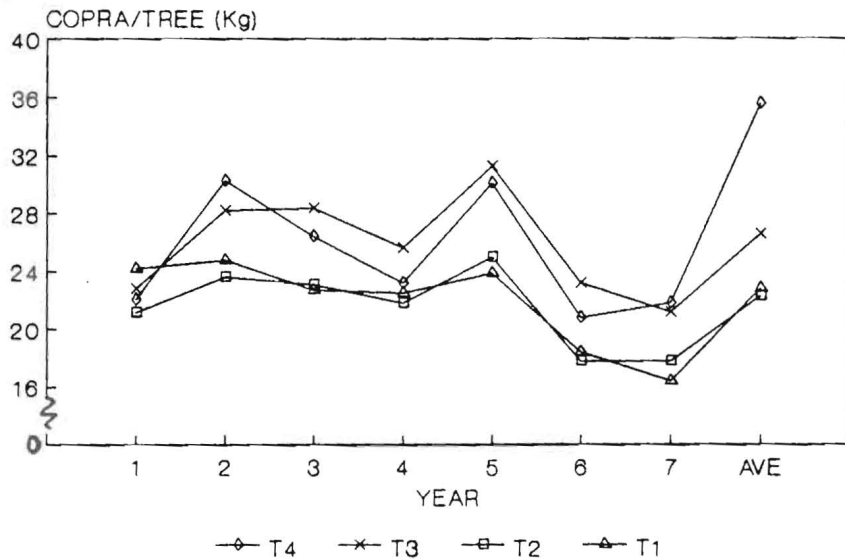


FIGURE 3
Copra production per tree in relation to various treatments

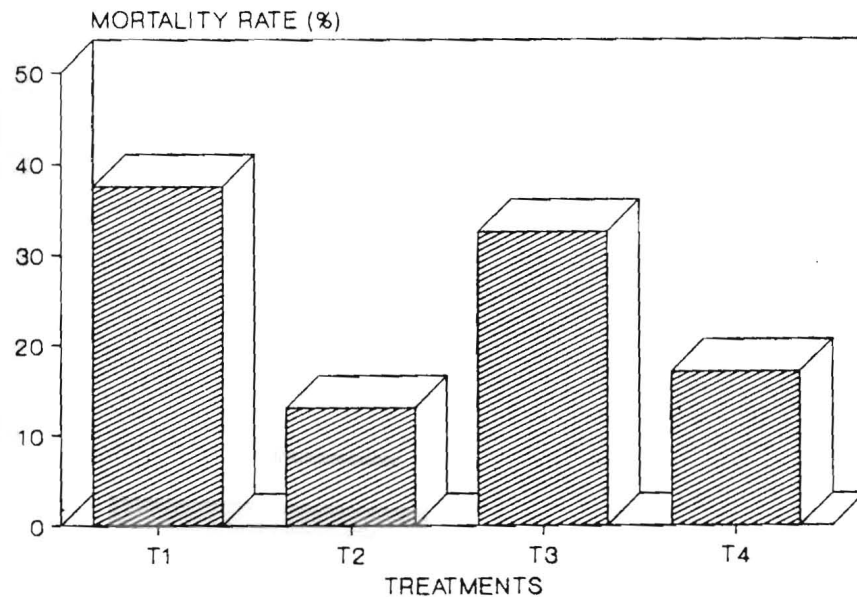


FIGURE 4
Percentage mortality of coffee at 1.5 years after planting

Fertilizer application increased coffee yield significantly regardless of whether the coconut was fertilized or not (Fig.5). Otherwise, even if coconut was fertilized, coffee yield did not increase indicating further that the coffee trees cannot benefit from the fertilizers applied on the coconut.

The annual average yield of treatment 4 (both coconut and coffee fertilized) was significantly higher than that of Treatment 2 (only coffee was fertilized). It is possible that competition for plant nutrients existed between coffee and the unfertilized coconut.

The significant increase in coffee yield of fertilized coffee over the unfertilized ones (with or without coconut fertilization) was accompanied by more number of coffee leaves in these treatments (Fig. 6 & Fig. 10).

Leaf Nutrient

Coconut - Fertilizer application did not significantly influence leaf nutrient contents, except for chloride (Cl) especially in the later years (Fig. 7). Leaf Cl levels increased in fertilized palms (Treatments 3 and 4) which may explain the slight increase in copra weight in these treatments. No response was noted even if other elements like N and S were applied in some of the treatments, suggesting that these are not limiting as far as coconut is concerned. Although, there were differences in some elements through the years, no definite trend could be established in relation to the fertilizers applied.

Coffee - There was an increase in the leaf N levels for those plots applied with ammonium sulfate (Fig. 8). The positive response to N application clearly demonstrates coffee's high requirement for it. The application of ammonium sulfate, likewise, improved leaf-S levels confirming preliminary observations that the limiting elements for coffee in the area are N and S. The increase in S, however, is accompanied with low levels of Cl and boron (B) implying the existence of antagonisms between S and Cl, and S and B (Fig. 9).

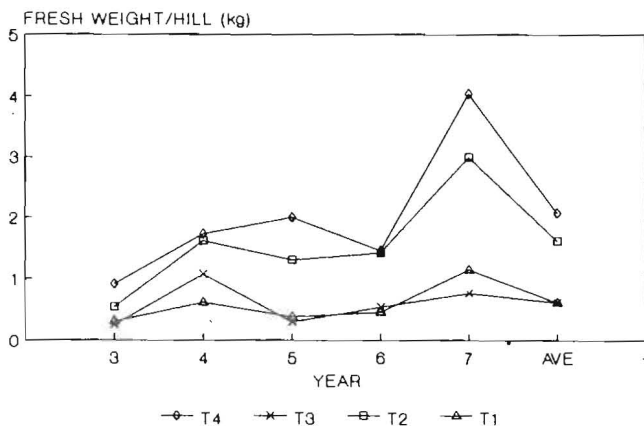


FIGURE 5 Yield of coffee in relation to the various treatments

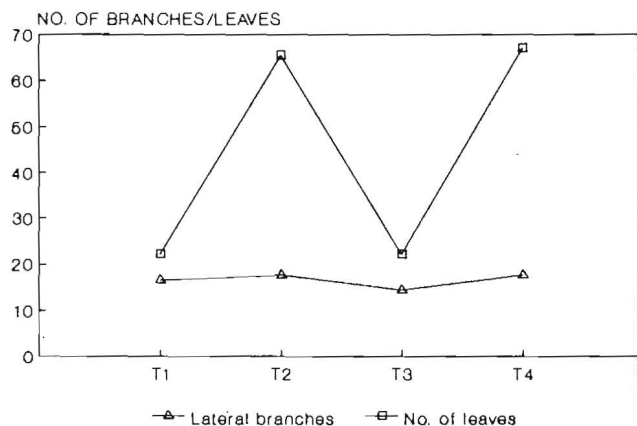


FIGURE 6 Growth of coffee (latest one yr) as affected by various treatments

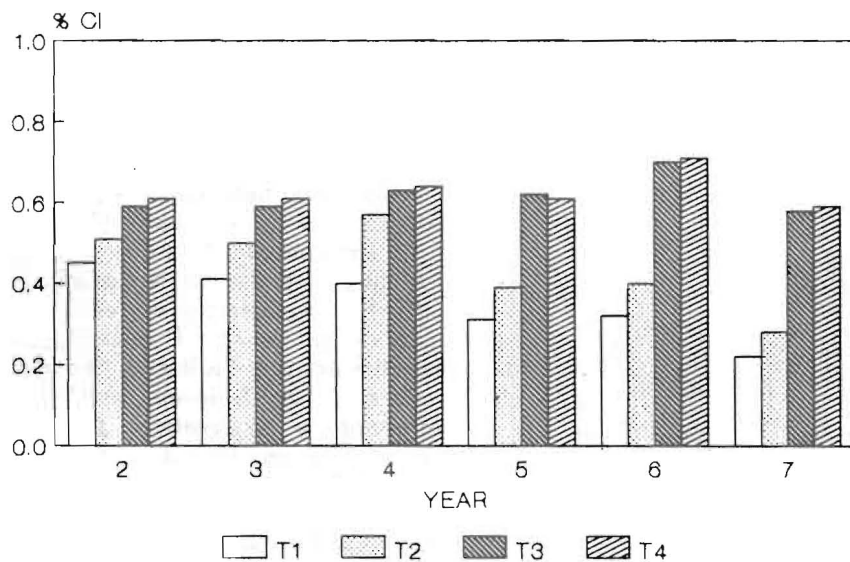


FIGURE 7 Leaf Cl content of palms in relation to the various treatments

Apparently, coconut and coffee have nearly similar nutritional requirements. Coconut absorbed N, K and Cl in large quantities while coffee absorbed N, K, Ca and Mg among other elements. This suggests a separate fertilizer application program for both crops when planted together in an intercropping system.

Economic Implication

Under the economic condition of 1991, the highest combined net profit from coconut and coffee of P26,987/ha/yr was obtained from Treatment 4 where both crops were fertilized (Table 1). This was followed by Treatment 2 where coffee alone was fertilized with net profit of P20,752. Even without fertilizer application on both coconut and coffee (control) a net income of P13,723 was realized.

However, this has to be interpreted with caution because the coconuts used in this study previously received blanket application of fertilizers making them still productive. Continuous non-application of fertilizer to coconut would surely be detrimental to coconut production due to the depletion of

soil nutrient reserves. In this particular study, the non-application of fertilizer to coffee (whether coconut was fertilized or not) produced a negative return which pulled down the combined net income of both crops.

CONCLUSION AND RECOMMENDATION

In an intercropping system involving coconut and coffee, fertilizer application on either crop increases only the yield of the fertilized crop but does not benefit the other. However, unfertilized coconut (owing to its extensive rooting system) tends to compete for nutrients with the fertilized intercrops reducing the yield of the latter even if the coconut does not significantly benefit in the process in terms of yield improvement.

Hence, there is a need to apply fertilizers separately to both crops based on their individual requirements to make the farming system more productive and profitable. Applying the fertilizer only on coffee may be adopted but not without caution, i.e. it should not be a prolonged practice and should be used only on previously well-nourished coconut.

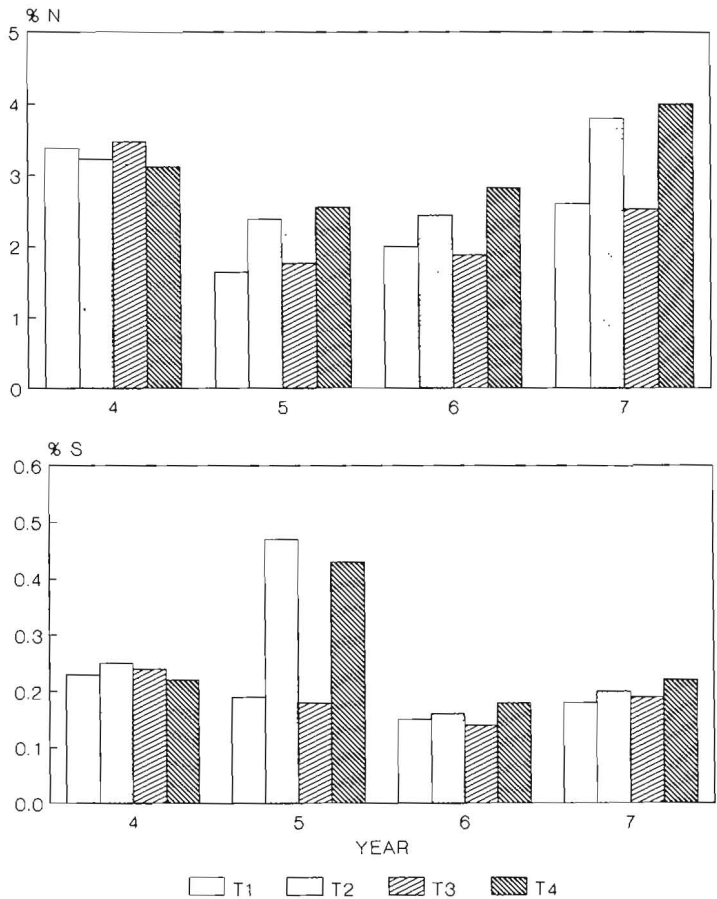


FIGURE 8 Leaf N and S levels of coffee in relation to the various treatments

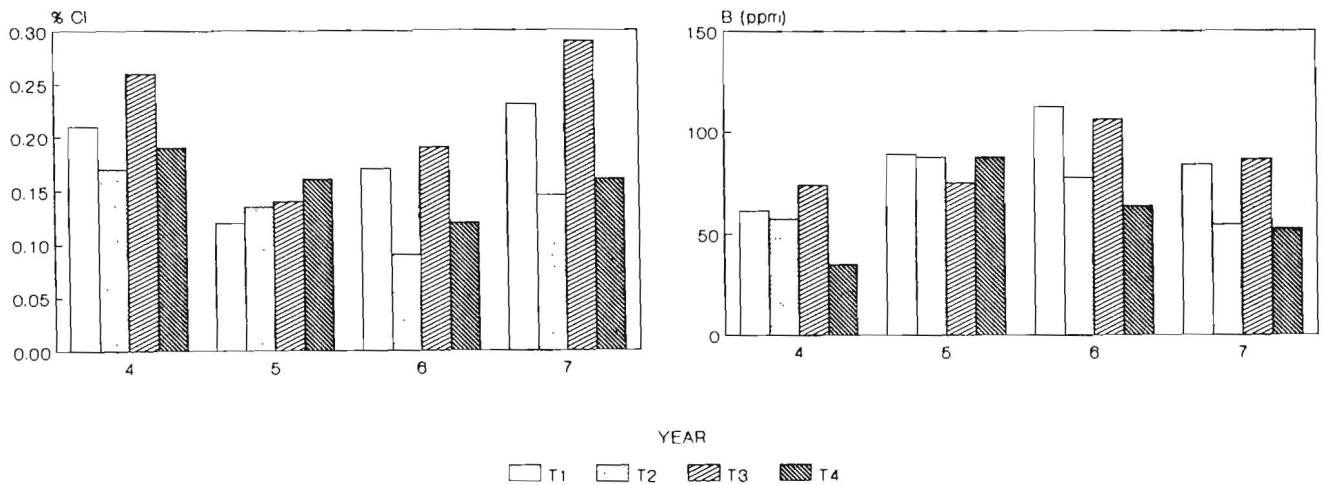


FIGURE 9 Leaf Cl and B levels of coffee in relation to the various treatments

REFERENCES

- FELIZARDO, B.C. 1983. Cultural management practices in coconut-based farming systems. Proc. Symposium on coconut-based farming systems. VISCA, Leyte.
- MARGATE, R.Z. and S.S. MAGAT. 1983. Coconut-based multi-storey cropping. Phil. J. Crop Sci. 8(2):81-86.



FIGURE 10

Left row : coconut fertilized + coffee unfertilized
 Right row : coconut fertilized + coffee fertilized

TABLE 1
Economic Analysis of the Different Treatments/ha*

TREATMENT	GROSS INCOME (P)	TOTAL COST (P)	NET BENEFIT/LOSS (P)	MBCR
T1 Coco unfert. + coffee unfert.	20,392	6,669	13,723	
T2 Coco unfert. + coffee fert.	28,775	8,023	20,752	6.19
T3 Coco fert. + coffee unfert.	23,423	7,667	15,756	3.03
T4 Coco fert. + coffee fert.	36,008	9,021	26,987	6.64

* combined income of coconut and coffee

APPENDIX TABLE 1
Soil Analysis at the End of the Study (surface)

TREATMENT	pH	O.M. (%)	EXCH. BASES (m.e./100g)				EXCH. ACID	CEC SUM	BASE SAT'N (%)
			Ca	Mg	Na	K			
1. Coco unfert + coffee unfert.	4.6	2.16	6.5	2.9	0.03	0.45	12.98	22.83	43.17
2. Coco unfert + coffee fert.	4.6	1.67	6.1	2.7	0.03	0.50	13.64	22.93	40.56
3. Coco fert. + coffee unfert.	4.7	1.92	6.1	2.6	0.03	0.51	13.35	22.44	40.84
4. Coco fert. + coffee fert.	4.6	1.67	5.6	2.8	0.03	0.41	12.85	21.77	41.22