Integrated Soil Fertility Management on Local Coconut Hybrid in a Farmer- Managed Coconut-Based Cropping System

By
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Abstract

An integrated soil fertility management or ISFM on-farm trial was conducted at Barangay Tawan-tawan, Baguio District, Davao City in 1993 to 1999 to know the effects of organic and inorganic fertilizers on the vegetative growth, nutrient status and yield performance of intercropped Catigan dwarf x Laguna tall (CATD x LAGT) coconut hybrid better known as PCA 15–1 or CATLAG.

Vegetative growth of CATD x LAGT palms revealed that ammonium sulfate + NaCl and goat manure + NaCl produced significantly bigger girth size on the first year and more number of leaves and living fronds on the second and fourth year, respectively. These treatments also enhanced early flowering (>50% @ 4.5 years) and yield (51-53 nuts/tree/yr @) 5 years from field planting) in hybrid palms. The organic fertilizers, i.e. goat manure and coconut husk, become more effective in their effect on the vegetative and reproductive characters of palms when combined with a Cl source (NaCl). The application of Cl nutrient contributed to the better performance of palms during the drought condition. The application of goat manure resulted in improved levels of soil nutrients as K, Ca, Mg and P, increased percent base saturation and lower soil acidity.

The use of local hybrid, PCA 15-1 and ISFM-based low cost production inputs such as ammonium sulfate, goat manure/coco waste (husk) and common table salt as well as intercropping suitable crops under young coconuts is a profitable package of technologies capable of improving and sustaining coconut farm productivity in the Philippines.

INTRODUCTION

One of the five major concerns to support the new Agriculture and Fisheries Modernization Act's (AFMA) Research, Development and Extension (R, D & E) Agenda is the enhancement of sustainable agriculture and environmental management of our natural resources. According to Prasad (1997), the ultimate goals or ends of sustainable agriculture are to develop farming systems that are productive and profitable, conserve the natural resource base, protect the environment and enhance health and safety in the long run.

Fertilization has proved to be beneficial to the coconut in all coconut growing areas in the world. In the Philippines, several workers reported very encouraging results (Mendoza and Prudente, 1972; Magat et al, 1975; Prudente and Mendoza, 1976; Margate et al, 1978 and Prudente et al, 1979), particularly on nitrogen and chlorine fertilization. Specifically, the application of fertilizers supplying N, Cl and S significantly improved nut production and copra yield per palm, three and two years, respectively after fertilization (Magat et al, 1980).

While chemical or mineral fertilizers usually produced significant and quick improvements on the yield of coconut, they also reduce the soil productivity, particularly the lowering of pH and the destruction of soil structures in the long range (Secretaria and Maravilla, 1992). With the high cost of

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inorganic fertilizers, coupled with the growing consciousness on the bad effects of injudicious application of inorganic fertilizers on our environment, better fertilizer management practices are being tried in coconut farming. Hence, the use of organic fertilizers in coconut in combination with inorganic fertilizers better known as integrated soil fertility management or ISFM for exploration and testing.

Several studies on organic fertilization (Cadigal et al, 1983, 1987; Cadigal and Prudente, 1983; Secretaria and Maravilla, 1992) had been conducted in coconut showing the positive effects of organic farming. It strongly appears that organic fertilizer is more of a soil conditioner in the early years (1-3) of application and as a fertilizer supplying about 25% of the nutrient requirement of coconut (N, P, K and S) at 4-5 years from initial regular annual application (Magat, 1991).

Considering the importance of enhancing soil fertility and moisture conservation, research efforts are now geared towards an integrated system of soil fertility management to sustain crop productivity by optimizing all possible fertilizer sources (organic and inorganic) of plant nutrients required for crop growth and development. Hence, this study was conducted at farmer's field in Davao City, Philippines from October 1993 to December 1999.

OBJECTIVES

1. To assess the effects of inorganic and organic fertilization (animal manures and farm by-products) on the vegetative and reproductive characters of local hybrid at farmer's field;
2. To generate a feasible and inexpensive fertilization practice and a coconut-based cropping pattern that could increase coconut productivity through increased soil fertility level;
3. To determine the economics of various fertilizer treatments and intercropping practice; and,
4. To validate, demonstrate and transfer to farmer's field appropriate research technology for improved and sustained farm productivity.

MATERIALS AND METHODS

Experimental Material

One year old Catigan dwarf x Laguna tall (CATD x LAGT) hybrid seedlings were used as materials. The seedlings were obtained from a nursery study on the effects of different polybagging media on the growth of these seedlings. These were planted at two farmer's fields (about 0.5 km away from each other) located at Barangay Tawan-tawan, Baguio District, Davao City. The farmer-cooperators were Messrs. Timoteo Adon and Efren Pedroso Sr., both residents of Brgy. Tawan-tawan, Baguio District, Davao City.

Experimental treatments and design

Five treatments were tested as follows:

T1 - Control (No fertilization)

T2 - Inorganic fertilizers (Ammonium sulfate {AS} + NaCl)

T3 - Goat manure (GM) + NaCl

T4 - Coconut waste (CW) + NaCl

T5 – NaCl

The study was laid out in randomized complete block design (RCBD) with three replicates and nine (9) experimental palms per plot. The seedlings were planted in a 9 x 9 meter distance triangular system. Since the seedlings were subjected to different treatments (from previous study)

and, therefore, of different growth performance, grouping of relatively homogeneous seedlings was considered as replicate to eliminate error to this factor.

Fertilization rate

The inorganic fertilizers (ammonium sulfate and NaCl) were applied once a year using the following recommended dosage per palm basis (The Coconut Committee, 1993):

Palm Age	Ammonium sulfate	NaCl
At field planting (FP)	150 g	160 g
6 months	200 g	200 g
1 year	500 g	480 g
2 years	750 g	720 g
3 years	750 g	1.25 kg
4 years	1.00 kg	1.35 kg
5-6 years	1.50 kg	1.70 kg

As for treatments 3, 4 and 5, the rate of NaCl was the same as in treatment 2, while rate of goat manure (in kg) applied once a year (during the start of rainy season) was as follows:

Age:	**FP**	**0.5yr**	**1yr**	**2yrs**	**3yrs**	**4yrs**	**5yrs**
GM*	1	2	3	4	6	8	10

* Based on PCA's on-farm fertilizer trials

For treatment 4, coco wastes (particularly coconut husk - about 50 pieces of whole nut husk split into 4-6 pieces) were placed around the base of the palms in addition to the application of NaCl.

Chemical analysis of fertilizer materials

FERTILIZER MATERIAL (in %)	**BASED ON ACTUAL ANALYSIS (in %)**					
	N	S	Na	Cl	K	Ca
Ammonium sulfate	20	24	0	0	0	0
Sodium chloride	0	0	50	50	0	0
Coco waste (husk)*	0.3	0.2	0	0.95	1.8	0.16
Goat manure	1.5	1.5	NA	NA	3.0	NA

* % dry matter (Eroy et al., 1990) NA - Not analyzed

Land preparation and field planting

Land preparation, i.e. plowing, harrowing were undertaken by the farmers. On the other hand, field lay-outing, i.e. staking for planting of seedlings was managed by the researchers and assisted by the farmer-cooperators. Field-planting of coconut seedlings was done by the farmers and some laborers of the PCA-Davao Research Center.

Intercropping the coconuts

In the early stage of the palms, the farmers were given the option to use the vacant spaces in between the rows of palms for intercropping provided all areas would be intercropped. The choice of intercrops was decided by the farmers in consultation with the researchers depending on the farmers' needs, profitability and market opportunities of the intercrops.

During the first two years from field planting, peanuts (20 x 60cm distance) and corn (20 x 70 cm) were planted in replicate 1 and II while rice (20 x 60 cm) and corn in replicate III. Side-dress application of urea (45-0-0) was done in rice and corn while peanut was not fertilized. On the third year, banana was planted with a distance of 4 x 4 m in between rows of coconut palms in replicate III and in replicate I and II on the fourth year. Banana was fertilized with ammonium sulfate and potassium chloride (0-0-60).

On the fourth year, the same short season crops, i.e. peanut and corn were planted. At the same time, some fruit crops (durian and lanzones) were planted at 7 x 14 m distance under coconut and banana. On the sixth year, most of the old bananas planted were cut to avoid light competition between coconut and this intercrop.

Gathering of data

The following growth indices on coconut were gathered every six months after initial data recording at field planting time:

1) Girth circumference (up to third year)
2) Number of leaves produced and total living fronds (up to fourth year)
3) Height of palms (up to third year)
4) Number and time of flowering palms

On the fourth year from field planting, yield of early bearing palms was estimated based on the three oldest bunches (Magat, 1995). The data gathered from the intercrops was not only on their yield. Cost of production was also recorded for economic analysis.

Soil and leaf analyses

Soil sampling and analysis was done at the beginning of the study, 3.5 years thereafter and at 6 years from field planting to determine the soil fertility of the farmers' field during the duration of the study.

Leaf sampling and analysis was done annually at leaf rank number 4 starting in 2.5 years, 3.5 years and 6 years from field planting and at leaf rank number 9 in third to sixth year.

RESULTS AND DISCUSSION

Vegetative growth characters

The effects of fertilizer treatments on the vegetative characters of CATD x LAGT (PCA 15-1), the first local hybrid produced by PCA, was noted. In the first year of growth, girth size was the only character significantly affected by the treatments with palms fertilized with inorganic fertilizers (AS + NaCl) having the biggest girth circumference (Table 1 and Fig. 1). Palms treated with goat manure, coco waste combined with NaCl and NaCl alone showed comparable girth size with the inorganic fertilized palms but were statistically the same with those of the unfertilized palms. From the second to the third year, girth size was no longer affected by the different fertilizer treatments.

For plant height, no significant response of palms was observed from the first to the third year (Table 1). However, generally the palms with AS + NaCl and goat manure + NaCl were the tallest compared to the palms given other treatments. The shortest palms were observed in two treatments: (1) without any fertilizer; and, (2) NaCl alone.

The number of leaves and total living fronds produced per year were significantly affected by the treatments on the second and fourth year after field planting, respectively (Table 2). The highest number of leaves and living fronds produced were observed in palms applied either with AS + NaCl or goat manure + NaCl which were both significant over the control palms.

The improved leaf production rate and total living fronds observed in palms with AS and goat manure applications, combined with NaCl, indicates that goat manure could be a substitute for ammonium sulfate as source of nitrogen nutrient. This result confirms earlier findings on the potential of goat manure as an effective source of nutrient for coconut palms (Cadigal et al, 1987; Secretaria and Maravilla, 1992). Furthermore, the effectiveness of goat manure is enhanced when combined with NaCl as exemplified in this study and recommended in the previous studies (Secretaria and Maravilla, 1997; Margate et al, 1997).

Flowering observation

The palms that first flowered came from treatments with goat manure + NaCl and ammonium sulfate + NaCl in three years from field planting. Regular monitoring of the flowering of palms every three months starting on the third year showed early precocity of CATD x LAGT palms in treatments with inorganic fertilizers (AS + NaCl) and goat manure + NaCl as manifested in the higher percentage of flowering palms with these treatments (Fig. 2). The palms with treatments of coco waste + NaCl and NaCl alone started flowering at 3.5 years while the unfertilized palms flowered at 4.5 years from planting. It could be observed that in 4.5 years from planting, hybrid palms reached more than 60% flowering when fertilized with inorganic fertilizers (AS + NaCl), goat manure and coco waste both combined with NaCl in contrast with only about 10% flowering for non-fertilized palms. This result confirms again earlier studies on the effect of inorganic and organic fertilizers on the precocity of hybrid palms which shows that compared with inorganic fertilization, the combination of inorganic and organic fertilizers enhanced early flowering in coconut. Consequently, earlier nut production is expected from these palms (Figs. 3 & 4).

Yield of palms

Nut yield of hybrid palms was initially estimated in the fourth year based on the three oldest bunches (Magat, 1995). The palms treated with AS + NaCl produced higher number of nuts/tree/year compared to other treatments. Although the number of nuts/tree/year for palms with goat manure + NaCl was lower than that of coco waste + NaCl and NaCl alone, the former had more bearing palms than the latter treatments. This finding substantiates the previous result that earlier and higher productivity could be obtained from palms fertilized with ammonium sulfate and goat manure combined with NaCl.

The yield response of CATD x LAGT hybrid further indicates its higher productivity as compared to local tall variety 'Laguna' (LAGT) where initial yield of palms from this variety with the same fertilizer rates of ammonium sulfate and NaCl showed a lower number of nuts (59) per tree per year (Margate et al, 1996).

In the succeeding years, the palms produced lower number of nuts /tree/year as a result of the dry spell experienced by the palms on the last quarter of 1997 to second quarter of 1998. It is interesting to note, however, that palms fertilized with organic materials such as goat manure and coco husk combined with the common table salt (NaCl) still had higher number of nuts/tree/year and more bearing palms than those with ammonium sulfate + NaCl, particularly on the sixth year (Table

3). The palms with organic materials such as coconut husk and animal manures known to improve the soil structures in terms of their bulk density and water holding capacity (Secretaria and Maravilla, 1996) could have benefited from these naturally-occurring fertilizers during the drought period, resulting in better yield performance of palms than those fertilized with inorganic material, i.e. ammonium sulfate. Likewise, the role of Cl element in increasing the tolerance of coconut palms to drought in addition to improving the growth and yield of hybrid palms (Margate, 1983) contributed to this good observation. This present finding also proved positively the earlier claim that when palms fertilized with organic materials lacked Cl element, they were adversely affected in terms of vegetative and reproductive performance.

The essential nature of chloride as a major drought factor was confirmed by Braconnier and d'Auzac (1989) as cited by Secretaria & Maravilla (1997). They found that the Cl-ion is involved in drought resistance phenomena and that its presence enables coconut palms to keep their stomata open longer during the day and attain a highly negative water potential; hence, benefiting from a sufficient water drawing capacity to maintain cell turgidity. These two actions enable optimization of the balance between transpiration and assimilation, thereby leading to better stress tolerance. On the other hand, soil with high organic matter such as from naturally occurring fertilizers had higher capacity to retain water. This improved physical condition of the soil allows for better root development, thus absorption of water and nutrients is greatly enhanced (Mangawang, 1993).

At the end of the sixth year from field planting, actual nut harvesting was done on the experimental palms. Among the treated palms, those fertilized with goat manure + NaCl showed higher number of nuts per palm and heavier whole nut weight (Table 3). This was followed by palms with NaCl alone and coco waste + NaCl. From the initial nut harvest, samples of five nuts of CATD x LAGT (regardless of treatments) were analyzed for their nut components. The analysis showed that the average whole nut of this hybrid is about 1,130 g with 32% husk, 16% water, 16 % shell and 35% fresh meat. Based on the guide on estimation of nut to copra conversion factor or NCFF (Magat, 1995), about 3.25 to 3.5 nuts are needed to produce a kilo of copra from this hybrid population.

Leaf nutrients

Leaf analysis results from leaf rank number 4 of 2.5 and 3.5 years old hybrid palms showed significant effect of the fertilizer treatments on the Na and Cl levels since NaCl was used as one of the inorganic fertilizers in all treatments except in the control (Table 4). All treated palms had significantly higher Cl levels than the unfertilized palms. This explains the excellent performance of the treated palms in terms of their vegetative growth. As to leaf Na level at 2.5 years old, the T2 gave the highest level of Na while the other treated palms had Na level comparable with T2 but still statistically the same with the level of unfertilized palms. A year after (3.5 years), the level of Na for T4 and T5 became statistically the same with T2 level.

At six years old, hybrid palms showed significant effect of fertilizer treatments on leaf N, Na, Cl, B and Mn. It is interesting to note that the highest leaf N content was observed on palms treated with goat manure + NaCl followed by those fertilized with AS + NaCl. This again clearly indicates that goat manure could substitute ammonium sulfate as a source of N for the hybrid palm. This also explains the good vegetative and yield performance of palms fertilized with goat manure + NaCl. The N levels of all treated palms were low (below critical levels). However, considering that the actual appearance of coconuts were normal, the low N leaf levels could be due to the dilution effect especially that they produced more leaves.

As for Na and Cl elements, all treated palms had significantly higher levels than unfertilized palms with AS + NaCl and coco husk + NaCl treated palms having the highest level for Na and Cl, respectively. For B, it strongly appears that Cl application had a depressive effect on B level, since the treated palms had lower B level, while the unfertilized palm had the highest B level. However, for Mn, there seems to be a positive effect of Cl application on Mn level with the highest from AS +

NaCl and cocohusk + NaCl treatments, the lowest from unfertilized treatment. No significant effect of fertilizer treatments was observed on Zn, Cu and Fe.

Effect on soil properties

Benchmark information of the soil revealed that the organic matter, like available P was considered low; but adequate in K. Hence, the use of NaCl for this experiment to supply Cl to the palms (Table 5). The soil was very strongly acidic with pH level ranging from 4.7 to 5.0 (Table 5). After about four years of fertilization, some changes on the pH level could be observed; i.e. pH level in all treatments increased to moderately acidic level. Among the treated palms, those with inorganic fertilizers (AS + NaCl) had the lowest pH level of 5.5 indicating a more acidic level compared to the other treatments. This was brought about by the release of H^+ ions by ammonium sulfate in the soil. But with the application of organic fertilizers as in T3 and T4, soil was maintained at moderate acidity. Even without fertilization, the soil pH increased over the benchmark value due to nutrient recycling of bases Ca, Mg, K and O.M while P was further reduced in all treatments. The extractable K was maintained especially with goat manure treatment at 250 ppm. Besides the inherent capacity of the soil to improve pH, the application of organic fertilizer (goat manure, cocowastes) supplies beneficial microorganisms favorable to the soil.

At the end of sixth year, generally the soil of the experimental palms became extremely acidic (particularly that of ammosul + NaCl) except for those with the goat manure + NaCl treatment where pH level was higher (strongly acidic) than the others, both for top and subsoil levels. It could be noted that at this pH level of soil from goat manure + NaCl treatment, higher values for most of the elements were observed e.g. P, extractable K, exchangeable bases (Ca, Mg, Na, K) and base saturation point. Such acidity level is still suitable for coconut growing compared to the higher acidity level of the other treatments. These factors could have contributed to the better soil fertility level of palms with goat manure + NaCl due to its accumulation or residual effect; and, consequently, better vegetative and yield performance of the palms.

Intercropping under coconuts

Corn + peanut (Fig. 5), corn + rice and corn + peanut + rice cropping patterns were tried by the farmer-cooperators in one to two years from field planting which proved to be a profitable coconut-based cropping systems. This intercropping practice helped the farmers earn some income while the coconut palms were still on their pre-bearing stage (Table 6).

In the third year, some intercrops were again planted by the farmer-cooperator in the interrows of young CATD x LAGT palms. However, compared with the previous year's income from intercropping, a lower income was realized due to the damage to the intercrops (corn, rice and peanut) by insects (larval stage).

In the fourth year, several intercropping patterns were introduced by the farmer-cooperators. Four coconut cropping systems involving high value tropical fruits and short season crops were done on the first two replicates, as follows:

Coconut + banana + lanzones

Coconut + banana + corn (Fig. 6)

Coconut + banana + durian + peanut + corn

Coconut + banana + durian + peanut (Fig .7)

Only banana + corn were planted under coconut palms on the third replicate.

These coconut–based cropping systems could have proven to be a very profitable production strategy were it not for the drought that occurred from the last semester of 1997 to first semester of 1998. Consequently, no income was realized by the farmers from its short season crops in the fourth to fifth year. A small amount of income was realized from banana planting in the fifth year.

This CBFS practice in farmer's field showed that a number of considerations must be met to ensure high economic benefits. Some of these are: 1) suitable environmental condition (favorable climate + soil); 2) appropriate technology; 3) available planting materials; 4) right attitude of farmers; 5) favorable market for farm produce 6) available working capital (Magat, 1999).

Economic analysis

Based on the economic situation of 1994-99 during the early years of bearing, treatments with goat manure + NaCl with various coconut-based cropping pattern gave the highest total net benefit (for 6 years) of P44,034.90/ha followed by inorganic fertilizers (AS + NaCl) treatment with P38,240.90 (Table 7). Figure 8 shows the status of experimental palms as affected by the fertilizer treatments at six years old. Using the dominance analysis [used to indicate that one alternative is superior to another in producing higher benefits (outputs) with equal or lower costs (inputs){ DARM 1990}] the treatments with inorganic fertilizers, goat manure + NaCl and coco husk + NaCl were not dominated, meaning their net benefits were higher (following increasing total variable costs) compared to those with lower total cost. The NaCl alone was the only dominated treatment. Hence, further analysis showed marginal rate of return (MRR) for the undominated treatments were 137%, 147%, 159%, respectively.

The MRR measures the return a farmer can expect to gain from each additional unit of investment in a new technology after deducting the cost of investment (DARMS, 1990). It should be 100% or more for a new technology to be economical and profitable. An MRR of 100% means that every P1.00 invested, the farmer can expect to recover the P1.00 plus an additional P1.00. Thus, we can observe from this result that the organic materials (goat manure + cocohusk) + NaCl gave higher MRRs than the inorganic fertilizer treatment. Hence, organic fertilizers are more profitable to use and, at the same time, can substitute for the commercial N-containing inorganic fertilizer (Ammosul) as source of nutrients.

CONCLUSION AND RECOMMENDATIONS

The application of recommended rates of inorganic fertilizers (ammonium sulfate and NaCl) and combination of organic (goat manure) + NaCl improved significantly the vegetative growth characters of local hybrid palms CATD x LAGT (PCA 15-1). Likewise, these two fertilizer treatments enhanced early flowering and yield of hybrid palms as compared to palms with coco waste (husks)+ NaCl, NaCl alone and the control.

The fertilizer treatments affected significantly the leaf nutrients Na and Cl as early as 2.5 years of fertilization. In the sixth year, leaf N, Na, Cl, B and Mn were significant affected by fertilizer treatments particularly those palms with AS + NaCl and goat manure + NaCl treatments. This explains the better performance of these palms in terms of their precocity and yield compared to the other treated palms. Improved soil conditions (P, extractable K, exchangeable bases and base saturation point) of the experimental palms with the accumulation or residual effect of organic fertilizer (goat manure) + NaCl likewise contributed to its good performance.

The recommended rates of inorganic and organic fertilizers for better performance of local hybrid palms at the different stages for this particular place of study and similar locations are as follows:

Palm Age	Ammonium sulfate + NaCl or		Goat manure + NaCl	
At field planting	150 g	160 g	1 kg	160 g
6 months	200 g	200 g	2 kg	200 g
1 year	500 g	480 g	3 kg	480 g
2 years	750 g	720 g	4 kg	720 g
3 years	1.00 kg	1.25 kg	6 kg	1.25 kg
4 years	1.25 kg	1.35 kg	8 kg	
5 years & more	1.50 kg	1.70 kg	10 kg	

The application or use of goat manure combined with Cl fertilization would be practical if goat manure is available in the farm such as in coconut and goat raising farming system. While for coconut husks which are always available in coconut farms, mulching 50 pcs per palm + common table salt which is cheap and very affordable (same rate as indicated at above table per fertilization schedule) would be a very practical and inexpensive fertilization practice.

Intercropping of profitable short season crops e.g. peanut, corn and rice, annual crop like banana in the interrows of young coconut provides early income for the farmers even at pre-bearing stage of coconut. The success and profitability of CBFS as experienced in this study depends on several factors, namely: favorable environment (climate, occurrence of pest, etc), appropriate technology, right attitude of farmers, available market and working capital.

These results strongly indicate that the use of low cost production inputs such as ammonium sulfate or goat manure/coco husk combined with NaCl as sources of nutrients could improve the vegetative growth and enhance early reproductive performance of CATD x LAGT hybrid palms. The integration of inorganic and organic fertilizers better known as integrated soil fertility management scheme proved to be an economical and profitable production management system for coconut. In addition to this, intercropping practice under young coconuts using some profitable short season crops could help improve and sustain coconut farm productivity in the Philippines.

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Table 1. Vegetative characters of CATD x LAGT hybrid at different growth stages

Treatment	Girth size (cm			Height (cm)		
	Yr 1	Yr 2	Yr 3	Yr 1	Yr 2	Yr 3
T1-Control	17.3 b	41.3	65.5	164.9	289.3	435.7
T2-AS+NaCl	24.5 a	62.7	102.1	166.9	328.5	513.5
T3-GM+NaCl	22.8 ab	59.1	95.1	182.7	344.2	481.4
T4-CW+NaCl	23.0 ab	62.1	95.6	189.7	339.1	473.0
T5-NaCl	22.4 ab	54.5	92.6	177.3	340.1	366.6
Stat. Sign.	*	ns	ns	ns	ns	ns
Coeff of Var.(%)	9.6	14.8	15.7	13.3	8.2	11.5

ns - Treatment effect is not significant

* - Treatment effect is significant at 5% level of significance

Treatment means with the same letter(s) are not significantly different from each other (HSD test)

Table 2. Leaf production of CATD x LAGT palms at different growth stages

Treatment	Annual leaf prodn. (no.)				Living fronds (no.)			
	Yr 1	Yr 2	Yr 3	Yr 4	Yr 1	Yr 2	Y3	Y4
T1-Control	2.5	6.9 b	7.3	8.4	4.7	7.6	8.3	10.3 b
T2-AS+NaCl	2.9	8.8 a	9.4	10.4	5.5	9.1	11.1	13.7 a
T3-GM+NaCl	3.2	8.5 ab	9.0	9.9	5.7	9.3	11.0	13.7 a
T4-CW+NaCl	2.9	8.0 ab	8.4	9.1	5.6	9.4	10.4	12.9 ab
T5-NaCl	3	7.8 ab	8.6	11.0	5.3	8.7	10.6	11.2 ab
Stat. Sign.	ns	*	ns	ns	ns	ns	ns	*
Coeff of Var.(%)	10.2	7.1	8.7	12.9	7.5	10.6	10.7	9.8

ns - Treatment effect is not significant

* - Treatment effect is significant at 5% level of significance

Treatment means with the same letter(s) are not significantly different from each other (HSD test)

Table 3. Estimated annual nut yield per palm and actual yield of CATD x LAGT palms

Treatment	Annual nut count (average of 3 replicates)			Nuts/palm[1]	Whole nut
	1997	1998	1999	(no.)	wt. (g)
T1- Control	-	-	1.7 (2)	0.3	850.0
T2- AS + NaCl	82 (4*)	51.0 (12)	17.0 (14)	2.9	966.7
T3 - Goat manure+NaCl	56 (4)	53.1 (11)	22.4 (17)	4.6	1,350.0
T4-Cocowaste + NaCl	64 (1)	26.4 (5)	18.5 (15)	3.2	1,183.4
T5 - NaCl alone	60 (1)	26.0 (8)	21.5 (14)	4.0	1,300.0

* number of palms with nut harvest

[1] One actual harvest data

Table 4. Leaf analysis results (in %) of CATD x LAGT palms at different growth stages

Age fr. FP	Treatment No.	N	P	K	Ca	Mg	Na	Cl	S	Bppm
2.5 years	T1 - Control	1.375	0.132	1.640	0.247	0.180	.124 b	0.14 b	0.137	8.700
	T2 - AS + NaCl	1.630	0.126	1.351	0.239	0.208	.363 a	.603 a	0.141	7.700
	T3 - GM + NaCl	1.484	0.126	1.624	0.238	0.200	.262 ab	.528 a	0.132	8.300
	T4 - CW + NaCl	1.640	0.129	1.510	0.248	0.203	.309 ab	.713 a	0.152	8.600
	T5 - NaCl alone	1.355	0.126	1.483	0.277	0.194	.310 ab	.654 a	0.140	8.000
	Stat. Sign.	ns	ns	ns	ns	ns	*	*	ns	ns
	Coeff of Var. (%)	8.2	6.7	14.2	10.2	8.1	26.5	15.4	5.9	7.7
3.5 years	T1 - Control	1.629	0.134	1.561	0.221	0.246	.066 b	.124 b	-	9.9 a
	T2 - AS + NaCl	1.797	0.130	1.193	0.224	0.276	.289 a	.693 a	-	6.2 c
	T3 - GM + NaCl	1.693	0.134	1.361	0.229	0.285	.184 ab	.636 a	-	8.4 ab
	T4 - CW + NaCl	1.663	0.134	1.275	0.219	0.279	.229 a	.696 a	-	8.0 b
	T5 - NaCl alone	1.678	0.132	1.329	0.221	0.269	.209 a	.610 a	-	8.1 b
	Stat. Sign.	ns	ns	ns	ns	ns	**	**	-	**
	Coeff of Var. (%)	4.7	4.0	10.4	13.9	8.9	22.9	10.6	-	7.4

ns - Treatment effect is not significant

* - Treatment effect is significant at 5% level of significance

** - Treatment effect is highly significant at 1% level of significance

Treatment means with the same letter(s) are not significantly different from each other (HSD test)

Cont'd of Table 4.

Age fr FP	Treatment No.	N	P	K	Ca	Mg	Na	Cl	S	B ppm	Zn ppm	Mn ppm	Cu ppm	Fe ppm
6.0 yrs	T1 - Control	0.990 b	0.104	0.998	0.379	0.275	0.126 c	0.049 b	0.144	9.3 a	34.9	830.0 b	2.2	77.2
	T2 - AS + NaCl	1.241 ab	0.104	0.934	0.326	0.231	0.412 a	0.524 a	0.155	4.9 c	38.2	1694.7 a	3.4	108
	T3 - GM + NaCl	1.433 a	0.112	1.255	0.322	0.213	0.297 b	0.497 a	0.154	7.3 b	50.6	864.7 b	3.1	114
	T4 - CW + NaCl	1.071 b	0.104	1.03	0.33	0.249	0.339 b	0.532 a	0.147	7.7 ab	37.1	1116.8 ab	2.8	95.6
	T5 - NaCl alone	1.188 ab	0.104	1.04	0.32	0.241	0.353 ab	0.488 a	0.148	7.2 b	24.8	1073.1 b	3.1	83.0
	Stat. Sign.	*	ns	ns	ns	ns	**	**	ns	**	ns	**	ns	ns
	Coeff of Var. (%)	9.6	4.3	21.3	8.8	17.3	7.8	7.6	6.4	8.3	53.1	18.7	15.7	13.9

ns - Treatment effect is not significant

* - Treatment effect is significant at 5% level of significance

** - Treatment effect is highly significant at 1% level of significance

Treatment means with the same letter(s) are not significantly different from each other (HSD test)

Table 5. Soil analysis results of experimental area as affected by fertilizer treatments.

Location	Treatment	pH	% O.M.	P_{ppm}	Ext.K_{ppm}	% N	%Sand	% Silt	% Clay	Soil Cls
A. Initial (at Field Planting -FP)										
Rep I & II	Topsoil	4.8	2.0	12.0	240.0	0.10	25.0	30.0	45.0	Clay
	Subsoil	5.0	1.0	8.0	220.0	0.05	17.0	30.0	53.0	Clay
Rep III	Topsoil	4.7	2.0	10.0	248.0	0.10	27.0	30.0	43.0	Clay
	Subsoil	5.1	1.0	12.0	225.0	0.05	19.0	20.0	61.0	Clay

B. 3.5 years from FP							Exch. Bases (m.equiv./100 g soil)				
		pH	% O.M.	P_{ppm}	Ext. K_{ppm}	% N	Ca	Mg	Na	K	Sum
Topsoil	T1- Control	5.6	2.30	9.0	176.7	0.12	1.60	0.40	0.32	0.47	2.79
	T2-AS+NaCl	5.5	2.50	4.3	156.7	0.13	1.40	0.40	0.39	0.41	2.60
	T3-GM+NaCl	6.0	2.30	8.0	250.0	0.12	2.40	0.60	0.51	0.84	4.35
	T4-CW+NaCl	5.7	2.50	6.3	181.7	0.13	1.50	0.50	0.91	0.54	3.45
	T5-NaCl	5.8	2.30	5.7	122.7	0.12	1.70	0.50	0.49	0.54	3.23

C. 6.0 years from FP							Exch. Bases (m.equiv./100 g soil)					Exc.Acid	CEC(Sum)	Base Satn.
		pH	% O.M.	P_{ppm}	Ext. K_{ppm}	% N	Ca	Mg	Na	K	Sum		(%)	(%)
Topsoil	T1- Control	4.5	3.54	7.0	300.0	0.17	1.50	0.40	0.06	0.21	2.17	22.47	24.64	8.8
	T2-AS+NaCl	4.3	3.92	4.0	330.0	0.19	1.50	0.60	0.06	0.23	2.39	23.20	25.60	9.3
	T3-GM+NaCl	5.1	3.90	10.0	1080.0	0.19	2.40	1.30	0.19	0.70	4.60	18.90	23.50	19.6
	T4-CW+NaCl	4.7	3.83	6.0	390.0	0.19	1.60	0.50	0.15	0.27	2.52	22.70	25.22	10.0
	T5-NaCl	4.8	4.04	4.0	460.0	0.20	1.60	0.70	0.23	0.26	2.79	22.50	25.30	11.0
Subsoil	T1- Control	4.6	2.37	6.0	320.0	0.12	2.10	0.60	0.06	0.33	3.09	24.68	27.77	11.1
	T2-AS+NaCl	4.5	2.53	4.0	260.0	0.13	1.60	0.50	0.24	0.18	2.52	23.40	25.90	9.7
	T3-GM+NaCl	4.8	2.72	5.0	280.0	0.14	2.40	0.90	0.31	0.31	3.92	20.70	24.62	15.9
	T4-CW+NaCl	4.6	2.68	4.0	320.0	0.13	1.80	0.30	0.24	0.18	2.52	20.80	23.32	10.8
	T5-NaCl	4.7	2.96	7.0	365.0	0.15	2.80	0.40	0.49	0.18	3.87	21.20	25.07	15.4

Table 6. Cost and return (in pesos) analysis on intercropping practices under hybrid coconut at farmer's field.

Year	Eco. Index	Intercropping practice		
1994		Corn + peanut (1 ha)	Peanut + rice (0.5 ha)	Ave. of 1 ha
	Gr. Income	15,119.60	9,260.00	16,253.10
	Total Cost	3,650.00	2,851.00	4,334.00
	Net Income	11,469.60	6,409.00	11,919.10
1995		Peanut + rice + corn	Corn + rice	
	Gr. Income	12,350.00	4,050.00	10,933.00
	Total Cost	4,571.00	1,295.00	3,910.70
	Net Income	7,779.00	2,755.00	7,022.30
1996		Peanut + rice + corn	Corn	
	Gr. Income	8,732.00	2,200.00	7,288.00
	Total Cost	8,687.00	1,730.00	10,417.50
	Net Income	45.00	470.00	-3,129.50
1998		Banana	Banana	
	Gr. Income	5,300.00	3,500.00	5,867.00
	Total Cost	2,800.00	2,000.00	3,200.00
	Net Income	2,500.00	1,500.00	2,667.00

Table 7. Economic analysis * of different fertilizer treatments and various intercropping practices (based on three early bearing years of hybrid coconut)

Fert. Treatment	Gross Income (PhP)	Total Cost (PhP)	Net Income (PhP)	Dominance Analysis	MRR** (%)
T1 - No fertilizer	40,827.30	32,744.40	8,082.90		
T4 -Cocowaste +NaCl	87,807.30	50,862.20	36,945.10		159
T5 - NaCl Alone	87,528.90	51,703.20	35,825.70	D***	
T2 -AS + NaCl	93,224.10	54,983.20	38,240.90		137
T3-Goat manure+ NaCl	101,198.10	57,163.20	44,034.90		147

* Detailed economic analysis at Appendix A.

** Marginal rate of return $= \frac{\text{Increase in Net Income}}{\text{Increase in Total Cost}} = \frac{\text{NIT2 minus NIT1}}{\text{TCT2 minus TCT1}} \times 100\%$

(for un-dominated treatments)

*** Dominated treatment

Appendix A. Detailed economic analysis of fertilizer treatments and intercropping practice

1. AS + NaCl + Intercropping

Year	Gross Coconut[1]	Income Intercrop[2]	Total Coconut[3]	Cost Intercrop[2]	Net Coconut	Benefit Intercop
1	-	-	9,657.00	-	-9,657.00	-
2	-	16,253.10	2,063.00	4,334.00	-2,063.00	11,919.10
3	-	10,933.10	2,423.00	3,910.70	-2,423.00	7,022.40
4	27,172.80	7,288.10	8,044.00	10,417.50	19,128.80	-3,129.40
5	20,120.40	5,867.00	6,920.00	3,200.00	13,200.40	2,667.00
6	5,589.60	-	4,014.00	-	1,575.60	-
Total	52,882.80	40,341.30	33,121.00	21,862.20	19,761.80	18,479.10
G. Total*		93,224.10		54,983.20		38,240.90

2. Goat manure + NaCl + Intercropping

Year	Gross Coconut[1]	Income Intercrop[2]	Total Coconut[3]	Cost Intercrop[2]	Net Coconut	Benefit Intercop
1	-	-	9,954.50	-	-9,954.50	-
2	-	16,253.10	2,043.00	4,334.00	-2,043.00	11,919.10
3	-	10,933.10	2,297.50	3,910.70	-2,297.50	7,022.40
4	25,916.40	7.288.10	7,562.00	10,417.50	18,354.40	-3,129.40
5	24,561.60	5,867.00	8,574.50	3,200.00	15,987.10	2,667.00
6	10,378.80	-	4,869.50	-	5,509.30	-
Total	60,856.80	40,341.30	35,301.00	21,862.20	25,555.80	18,479.10
G. Total*		101,198.10		57,163.20		44,034.90

3. Coco waste + NaCl plus Intercropping

Year	Gross Coconut[1]	Income Intercrop[2]	Total Coconut[3]	Cost Intercrop[2]	Net Coconut	Benefit Intercop
1	-	-	9,190.00	-	-9,190.00	-
2	-	16,253.10	1,811.00	4,334.00	-1,811.00	11,919.10
3	-	10,933.10	2,025.00	3,910.70	-2,025.00	7,022.40
4	29,386.80	7.288.10	7,943.00	10,417.50	21,443.80	-3,129.40
5	10,627.20	5,867.00	4,333.00	3,200.00	6,294.20	2,667.00
6	7,452.00	-	3,698.00	-	3,754.00	-
Total	47,466.00	40,341.30	29,000.00	21,862.20	18,466.00	18,479.10
G. Total*		87,807.30		50,862.20		36,945.10

[1] See Appendix B for details

[2] See Appendix C for details

[3] See Appendix D for details

* For coconut + intercrops

4. NaCl alone + Intercropping

Year	Gross Coconut[1]	Income Intercrop[2]	Total Coconut[3]	Cost Intercrop[2]	Net Coconut	Benefit Intercop
1	-	-	9,164.00	-	-9,164.00	-
2	-	16,253.10	1,624.00	4,334.00	-1,624.00	11,919.10
3	-	10,933.10	1,842.00	3,910.70	-1,842.00	7,022.40
4	26,535.60	7,288.10	8,959.00	10,417.50	17,576.60	-3,129.40
5	11,502.00	5,867.00	4,325.00	3,200.00	7,177.00	2,667.00
6	9,510.00	-	3,927.00	-	5,583.00	-
Total	47,547.60	40,341.30	29,841.00	21,862.20	17,706.60	18,479.10
G. Total*		87,528.90		51,703.20		35,825.70

5. No fertilizer + Intercropping

Year	Gross Coconut[1]	Income Intercrop[2]	Total Coconut[3]	Cost Intercrop[2]	Net Coconut	Benefit Intercop
1	-	-	7,747.50	-	-7,747.50	-
2	-	16,253.10	607.50	4,334.00	-607.50	11,919.10
3	-	10,933.10	607.50	3,910.70	-607.50	7,022.40
4	-	7.288.10	607.50	10,417.50	-607.50	-3,129.40
5	-	5,867.00	607.50	3,200.00	-607.50	2,667.00
6	486.00	-	704.70	-	218.70	-
Total	486.00	40,341.30	10,882.20	21,862.20	10,396.20	18,479.10
G. Total*		40,827.30		32,744.40		8,082.90

[1] See Appendix B for details

[2] See Appendix C for details

[3] See Appendix D for details

* For coconut + intercrops

Appendix B. Annual yield and gross income from hybrid coconut (copra).

1. Whole nut weight (in g) per palm based on estimated nut count

Fertilizer Treatment	4th year	5th year	6th year
T1 - No fertilizer	-	-	1,445.00
T2 - AS + NaCl	79,264.40	49,301.70	16,434.00
T3 -GM + NaCl	75,600.00	71,685.00	30,240.00
T4 - CW + NaCl	86,400.00	31,241.80	21,892.90
T5 - NaCl alone	78,000.00	33,800.00	27,950.00

2. Copra weight/palm (in kg) based on 21% whole nut weight for CATD x LAGT*

Fertilizer Treatment	4th year	5th year	6th year
T1 - No fertilizer	-	-	0.30
T2 - AS + NaCl	16.65	10.35	3.45
T3 -GM + NaCl	15.88	15.05	6.35
T4 - CW + NaCl	18.14	6.56	4.60
T5 - NaCl alone	16.38	7.10	5.87

3. Copra weight/ha (in kg)

Fertilizer Treatment	4th year	5th year	6th year
T1 - No fertilizer	-	-	
T2 - AS + NaCl	2,264.40	1,676.70	465.80
T3 -GM + NaCl	2,159.70	2,046.80	864.90
T4 - CW + NaCl	2,448.90	885.60	621.00
T5 - NaCl alone	2,211.30	958.50	792.50

4. Gross income from Copra/ha (in PhP)**

Fertilizer Treatment	4th year	5th year	6th year
T1 - No fertilizer	-	-	
T2 - AS + NaCl	27,172.80	20,120.40	5,589.60
T3 -GM + NaCl	25,916.40	24,561.60	9,072.00
T4 - CW + NaCl	29,386.80	10,627.20	7,452.00
T5 - NaCl alone	26,535.60	11,502.00	9,510.00

* Obtained from 1999 summarized nut component analysis (NCA) of PHGC 03, Breeding & Genetics Division, PCA-Zamboanga Research Center, Zamboanga City

** Ave. copra price/kg = P12.00

Appendix C. Cost and return of intercropping practices at farmer's fields

1. Adon's Farm

1.1Date planted - Sept. 15, 1994
Date harvested - Dec. 15, 1994 (peanut)
- Jan. 5, 1995 (yellow corn)

A. Total Cost included:		Cost
a1) Plowing (2 times) P500 @		P1,000.00
a2) Harrowing (2 times) P80 @		160.00
a3) Furrowing (1 day)		80.00
a4) Seeds - Peanut (3.5 bags)		1,225.00
- Corn (3 kg) P60/kg		180.00
a5) Insecticide (Hytox)		135.00
a6) Crop Giant Liquid fertilizer		180.00
a7) Basal fertilizers (16-20-0)		100.00
a8) Planting (4 persons at P50@)		200.00
a9) Spraying (2 times)		160.00
a10) weeding (3 persons)		150.00
a11) Peanut removal from roots		80.00
	Total	**3,650.00**
B. Gross Income from:		
b1) Corn (22 sacks) - 1,115.5 kgs at P3.20/kg		3,569.60
b2) Peanut (33 sacks) at P350/sack		11,550.00
	Total	**15,119.60**

1.2 Date of planting - March 8, 1995 (peanut & corn)
- Apr. 15, 1995 (rice)
Date of harvesting - June 15, 1995 (peanut)
- July 5, 1998 (corn)
- Aug. 20, 1995 (rice)

A. Total cost included:		
a1) Contract plowing (3x) P600/plowing		180.00
a2) Weeding		1,000.00
a3) Crop giant (2 bags)		152.00
a4) Insecticide		124.00
a5) Fungicide (Dithane)		66.00
a6) Spraying		75.00
a7) Seeds - peanut		1,050.00
- rice		304.00
	Total	**4,571.00**
B. Gross Income from:		
b1) Peanut (10 sacks) P360/sack		3,600.00
b2) Rice (20 sacks) 50 kgs/sack @ P8/kg		8,000.00
b3) Corn (5 sacks) 50 kgs/sack @P3.00/kg		750.00
	Total	**12,350.00**

1.3 Date of planting - April 1996

A. Total cost included:	
a1) Land preparation	3,500.00
a2) Labor for planting	350.00
a3) Seeds - rice	500.00
- Corn	187.50

a4) Weeding		2,500.00
a5) chemicals		730.00
B. Gross Income from:		
b1) Corn		1,782.00
b2) Peanut		950.00
b3) Rice		6,000.00
	Total	**8,732.00**
2. Pedroso Farm		
2.1.Date of planting - March 16, 1994		
A. Total Cost included:		
a1) Plowing (11 days) @ P60/day/		660.00
a2) Harrowing (5.5 days)		330.00
a3) Planting labor : - peanut		165.00
- rice		275.00
a4) Planting materials : - peanut seed		340.00
- yellow corn seed		100.00
- rice		300.00
a5) Weeding		200.00
a6) Liquid fertilizer (crop giant)		76.00
a7) Spraying of liquid fertilizer (3 days)		240.00
a8) Harvesting		165.00
	Total	**2,851.00**
B. Gross Income from:		
b1) Peanut (16 sacks) P422.5/sack		6,760.00
b2) rice (5 sacks) P500/sack		2,500.00
	Total	**9,260.00**
2.2. Date of planting - March 16, 1995		
A. Total Cost included:		
a1) Labor - plowing		630.00
- planting		200.00
a2) Seeds		175.00
a3) Fertilizers		290.00
	Total	**1,295.00**
B. Gross Income from:		
b1) Rice (5 sacks - 275 kgs) P6/kg		1,650.00
b2) Corn (18 sacks - 800 kgs) P3/kg		2,400.00
	Total	**4,050.00**
2.3 Date of planting : April 1996		
A. Total cost included:		
a1) Land preparation		900.00
a2) Planting labor		120.00
a3) Fertilizers (2 bags 14-14-14)		710.00
	Total	**1,730.00**
B. Gross Income from:		
b1) Yellow corn (20 sacks) 1,100 kgs @ P2.2/kg		
	Total	**2,200.00**

Note:

No detailed cost of production and income statement for banana was given by the farmers (only summary)

Appendix D. Detailed Total Cost (Production) per ha for coconut

Basis: Total Cost includes:		Cost	Frequency
a) Hybrid seednut/pc		P10.00	
b) Fertilizer materials:			
Ammosul (21%N, 24% S) /kg		4.30	
NaCl (60% Cl) /kg		3.00	
Goat manure / kg		0.15	
Coconut husk / pc		0.15	
c) Labor (maintenance)/ man-day		90.00	
c1) Topbrushing for unfert tree		8 min/tree	3 x a year
c2) Ringweeding for fertilized tree		13 min/tree	3 x a year
c3) Mixing organic fertilizer		7 min/tree	once/yr
c4) Fertilizer appln for inorganic source		13min/tree	once/yr
for organic source		20 min/tree	once/yr
d) Copra processing		20% copra gross income	
e) Number of experimental trees/ha (143 minus 5%)		135	
f) Average copra price/kg		12.00	
1. AS + NaCl treatment			
a) First year			
a1) Hybrid seednuts (143 + 5% (7) for replants)		1,500.00	
a2) Selection, lay-outing, setting of seednuts (2 md)		180.00	
a3) Seedbed maintenance (8 md)		720.00	
a4) Lay-outing, staking, difgging of holes (24 md)		3,660.00	
a5) Planting, initial fertilization (12 md)		1,080.00	
a6) Fertilizer application (at 6mos. & 1 year stage)		697.00	
a7) Fertilizer materials (AS + NaCl)		833.00	
a8) Ringweeding for fertilizer trees		987.00	
	Total	**9,657.00**	
b) Second year			
b1) Ringweeding of trees		987.00	
b2) Fertilizer materials		727.00	
b3) Fertilizer application		349.00	
	Total	**2,063.00**	
c) Third year			
c1) Ringweeding of trees		987.00	
c2) Fertilizer materials		1,087.00	
c3) Fertilizer application		349.00	
	Total	**2,423.00**	
d) Fourth year			
d1) Ringweeding of trees		987.00	
d2) Fertilizer materials		1,273.00	
d3) Fertilizer application		349.00	
d4) Copra processing		5,435.00	
	Total	**8,044.00**	
e) Fifth year			
e1) Ringweeding of trees		987.00	
e2) Fertilizer materials		1,560.00	
e3) Fertilizer application		349.00	
e4) Copra processing		4,024.00	
	Total	**6,920.00**	

f) Sixth year		
f1) Ringweeding of trees		987
f2) Fertilizer materials		1560
f3) Fertilizer application		349
f4) Copra processing		1118
	Total	**4014.00**
2. Goat manure + NaCl treatment		
a) First year		
a1) Hybrid seednuts (143 + 5% (7) for replants)		1,500.00
a2) Selection, lay-outung, setting of seednuts (2 md)		180.00
a3) Seedbed maintenance (8 md)		720.00
a4) Lay-outing, staking, difgging of holes (24 md)		3,660.00
a5) Planting, initial fertilization (12 md)		1,080.00
a6) Fertilizer application (at 6mos. & 1 year stage)		1,366.00
a7) Fertilizer materials (GM + NaCl)		461.50
a8) Ringweeding for fertilizer trees		987.00
	Total	**9,954.50**
b) Second year		
b1) Ringweeding of trees		987.00
b2) Fertilizer materials		373.00
b3) Fertilizer application		683.00
	Total	**2,043.00**
c) Third year		
c1) Ringweeding of trees		987.00
c2) Fertilizer materials		627.50
c3) Fertilizer application		683.00
	Total	**2,297.50**
d) Fourth year		
d1) Ringweeding of trees		987.00
d2) Fertilizer materials		709.00
d3) Fertilizer application		683.00
d4) Copra processing		5,183.00
	Total	**7,562.00**
e) Fifth year		
e1) Ringweeding of trees		987.00
e2) Fertilizer materials		891.50
e3) Fertilizer application		913.00
e4) Copra processing		5,783.00
	Total	**8,574.50**
f) Sixth year		
f1) Ringweeding of trees		987.00
f2) Fertilizer materials		891.50
f3) Fertilizer application		915.00
f4) Copra processing		2,076.00
	Total	**4,869.50**
3. Coco-waste + NaCl		
a) First year		
a1) Hybrid seednuts (143 + 5% (7) for replants)		1,500.00
a2) Selection, lay-outing, setting of seednuts (2 md)		180.00
a3) Seedbed maintenance (8 md)		720.00
a4) Lay-outing, staking, difgging of holes (24 md)		3,660.00
a5) Planting, initial fertilization (12 md)		1,080.00
a6) Fertilizer application (at 6mos. & 1 year stage)		697.00
a7) Fertilizer materials (CW + NaCl)		1,353.00

	Total	**9,190.00**
b) Second year		
b 1) Fertilizer materials		1,305.00
b2) Fertilizer application		506.00
	Total	**1,811.00**
c) Third year		
c1) Fertilizer materials		1,519.00
c2) Fertilizer application		506.00
	Total	**2,025.00**
d) Fourth year		
d1) Fertilizer materials		1,560.00
d2) Fertilizer application		506.00
d3) Copra processing		5,877.00
	Total	**7,943.00**
e) Fifth year		
e1) Fertilizer materials		1,702.00
e2) Fertilizer application		506.00
e3) Copra processing		2,125.00
	Total	**4,333.00**
f) Sixth year		
f2) Fertilizer materials		1,702.00
f3) Fertilizer application		506.00
f4) Copra processing		1,490.00
	Total	**3,698.00**
4. NaCl alone		
a) First year		
a1) Hybrid seednuts (143 + 5% (7) for replants)		1,500.00
		180.00
a3) Seedbed maintenance (8 md)		720.00
a4) Lay-outing, staking, difgging of holes (24 md)		3,660.00
a5) Planting, initial fertilization (12 md)		1,080.00
a6) Fertilizer application (at 6mos. & 1 year stage)		697.00
a7) Fertilizer materials (AS + NaCl)		340.00
a8) Ringweeding for fertilizer trees		987.00
	Total	**9,164.00**
b) Second year		
b1) Ringweeding of trees		987.00
b2) Fertilizer materials		292.00
b3) Fertilizer application		349.00
	Total	**2,063.00**
c) Third year		
c1) Ringweeding of trees		987.00
c2) Fertilizer materials		506.00
c3) Fertilizer application		349.00
	Total	**2,423.00**
d) Fourth year		
d1) Ringweeding of trees		987.00
d2) Fertilizer materials		547.00
d3) Fertilizer application		349.00
d4) Copra processing		5,307.00
	Total	**7,190.00**
e) Fifth year		
e1) Ringweeding of trees		987.00
e2) Fertilizer materials		689.00

e3) Fertilizer application		349.00
e4) Copra processing		2,300.00
	Total	**4,325.00**
f) Sixth year		
f1) Ringweeding of trees		987.00
f2) Fertilizer materials		689.00
f3) Fertilizer application		349.00
f4) Copra processing		1,902.00
	Total	**3,927.00**
5. No fertilizer treatment		
a) First year		
a1) Hybrid seednuts (143 + 5% {7} for replants)		1,500.00
a2) Selection, lay-outing, setting of seednuts (2 md)		180.00
a3) Seedbed maintenance (8 md)		720.00
a4) Lay-outing, staking, difgging of holes (24 md)		3,660.00
a5) Planting, initial fertilization (12 md)		1,080.00
a6) Topbrushing of unfertilized trees		607.50
	Total	**7,747.50**
b) Second year		
b1)Topbrushing of unfertilized trees		
	Total	**607.50**
c) Third year		
c1) Topbrushing of unfertilized trees		
	Total	**607.50**
d) Fourth year		
d1) Topbrushing of unfertilized trees		
	Total	**607.50**
e) Fifth year		
e1) topbrushing of unfertilized trees		
	Total	**607.50**
f) Sixth year		
f1) Topbrushing of unfertilized trees		607.50
f4) Copra processing		97.20
	Total	**704.70**

Fig. 1. One year old CATD x LAGT palm applied with ammonium sulfate + common table salt (NaCl)

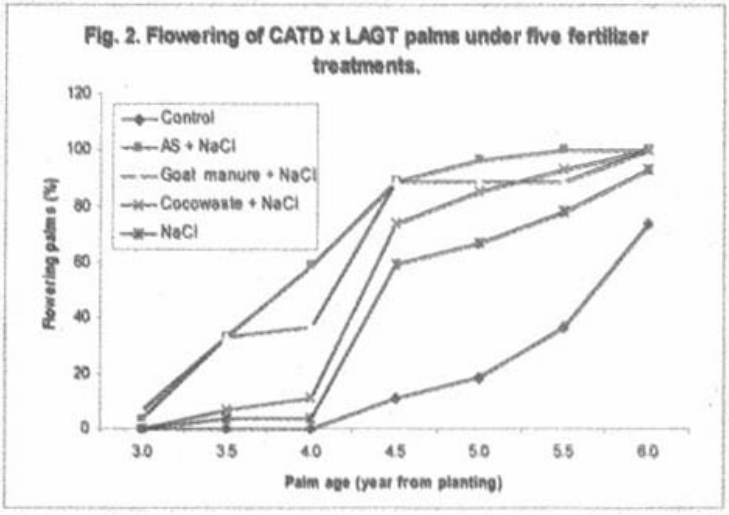

Fig. 3. Nut development and flower emergence in 3.5 years old palm with goat manure + NaCl fertilizers

Fig. 4. Three and a half years old CATD x LAGT palm with inorganic fertilizers (AS +NaCl) with fully developed nuts ready for harvesting

Fig. 5. Coconut + corn + peanut cropping pattern

Fig. 6. Coconut + banana + corn cropping pattern