RESIDUAL EFFECTS OF CHLORIDE FERTILIZERS ON YIELD OF COCONUTS GROWN ON AN INLAND SOIL OF DAVAO (Mindanao, Philippines)

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The beneficial residual effects (post-effects) of previous regular applications of chloride fertilizers on mature coconuts were evaluated in two long-term experiments conducted in an inland Tugbok soil (typic Tropudalfs) of Davao, Mindanao (Philippines). These studies involved: Cl fertilizers (KCl, NaCl, and NH_4Cl) at 0.80 kg Cl/tree/yr; and NaCl (common salt) at increasing rates of 0.0, 0.88, 1.76, 3.52, and 7.04 kg/tree/yr.

Results showed clear evidence of positive residual effects of Cl fertilizers at 0.80 kg Cl/tree in terms of nut production and copra (weight per nut and yield per tree) for 3-5 yr after regular fertilization of either KCl, NaCl, or NH_4Cl. Yield of coconuts remained at high levels as a result of leaf-Cl maintained at optimum levels (0.50%-0.60% Cl, leaf #14), even without fertilizer application for the following 5 yr. At higher rates of NaCl fertilizer (1.76-7.04 kg/tree/yr) applied regularly for 5 yr, the residual response in terms of nuts and copra yield tended to occur for a longer period of 5 yr. Except soil Na, soil properties were not significantly affected by NaCl application.

Implications of the findings are discussed in relation to sound coconut crop agronomy and soil management in coconut production.

Keywords: Chloride, chloride fertilizers, coconut fertilization, potassium chloride, sodium chloride, ammonium chloride, common salt, fertilizer residual effects.

INTRODUCTION

The growth and yield response or performance of the current stands of crop to fertilizers applied previously to the same stands is usually considered as residual effect(s). This is common on crops and soils applied with fertilizers containing N, P, K, and Na as these elements tend to accumulate in the soil and plant systems, particularly at high-level and continuous application. In some instances, the residual effects from earlier fertilizer application may be depressive, probably due to nutrient imbalance (toxic) levels.

Even in recent years, very little attention has been given to the residual effects of the anion components of fertilizers as Cl, particularly with KCl and NaCl (as source of K and Cl nutrients) application on coconut. This is attributed to the belief that negatively charged ions like Cl-, NO_3^-,SO_4^{-2} are not adsorbed by the soil, thus easily leached down the soil profile. This is not exactly true as Magat (1985) confirmed the capability of soils to retain Cl by absorption in the fine structural soil aggregate (Tucker 1982). After a 2-yr cropping of *Beta vulgaris* (fodder beet), high concentrations of Cl, Na, and K resulting from the application of KCl and NaCl were still found in the topsoil (20-40 cm) of two silt loam soils of New Zealand (Magat 1985).

This paper presents an evaluation of the residual effects of two separate long-term fertilizer studies on coconut conducted at the PCA-Davao Research Center, situated in an inland area of Mindanao. Implications of the findings should be useful in the rehabilitation of existing stands of coconut and in the fertilizer management of replanted farms, as well as new plantings.

MATERIALS AND METHODS

Environmental Conditions

Details of the location, climate, and soil conditions of the experimental sites (both studies) have been reported (Magat et al. 1975; Magat and Padrones 1984; Magat et al. 1987). It is located about 11 km (inland) from the coast, 120-160 m above sea level, with a deep and well-drained soil classified as typic Tropudalfs. The soil has: average pH of 6.5; 0.45 meq K, 0.11 meq Na, 5.7 meq Mg/100 g, 70% base saturation, clay loam surface soil, and clay subsoil (Table 1).

Experimental Palms

Laguna tall palms (30-35 yr old) planted in 8 m x 8 m square were used in the experiment.

Fertilizer Treatment

Study I involved the chlorine sources at 0.80 kg Cl/tree/yr, with the following treatments:

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T1 - Control
T2 - 1.82 kg KCl
T3 - 1.78 kg NaCl
T4 - 1.60 kg NH_4Cl

Including control palms, 2 kg $(NH_4)_2SO_4$/tree/yr as blanket fertilizer was applied to insure palms receive adequate amounts of N and S which are also limiting yields in Davao.

Treated in Study II were the same trees used earlier for the KCl rates study (1975-80). The five rates of NaCl are: 0.0, 0.88, 1.76, 3.52, and 7.04 kg/tree/yr, with corresponding Cl rates of 0.0, 0.48, 0.97, 1.94, and 3.87 kg/tree, respectively. As in Study I palms received 2 kg/tree blanket applications of $(NH_4)_2SO_4$.

In both studies, fertilizers were applied in split-application at 6-mo interval by broadcast and incorporation method, within the 1.0 m-1.5 m circle-weeded area of palms.

Experimental Design

Study I with four treatments (Cl sources) and three replications was arranged in a Randomized Complete Block Design (RCBD), while Study II with five NaCl rates replicated three times was laid out also in RCBD. Both Studies I and II consist of nine palms per treatment (plot size).

Harvesting and Yield Estimates

In both studies, mature nuts were harvested every 45 days (8 times per year) at which 20 nuts/plot were sampled for copra weight per nut as basis of copra yield (yield/tree x copra/nut).

Sampling of Leaves and Soil

Periodic sampling (both studies) of leaves (leaf #14) following the procedures of Magat and Froilan (1976) was done, and samples were immediately submitted to the PCA Tissue Analysis Laboratory. Samples were analyzed usually for concentrations of N, P, K, Ca, Mg, Na, Cl, and S. However, soil sampling for soil analyses (some soil properties) was done only in Study II.

RESULTS AND DISCUSSIONS

Study I - Residual Effects of Three Chlorine Sources

In 1982, the final year of 5 yr of regular fertilization (NaCl, KCl, and NH_4Cl), results showed that yield of coconuts, especially in terms of copra weight per nut and copra yield per palm, was significantly increased by Cl fertilization (Magat and Padrones 1982). As to nut production then, NaCl and NH_4Cl applications produced significantly more nuts compared to control palms.

The behavior or performance of palms in ensuing years after the last annual fertilization was stopped could indicate the response of palms to earlier Cl fertilizers, considered as the residual effects. This covers the production period 1983 to 1988 of Study I.

Nut Production

In general, from 1983 to 1987 (5 yr) nut production of palms applied with Cl fertilizers (NaCl, KCl, and NH_4Cl) was clearly higher than those of control palms (Fig. 1a). The lower production in years 1983 and 1986 is mainly attributed to inadequate rainfall. It appears that after 6 yr from the withdrawal of application of Cl fertilizers, nut production starts to decline as indicated by similar yields of fertilized and unfertilized palms. This likely shows that bearing palms which receive regular fertilization (3-5 yr) are expected to maintain high nut yields for the next 3-5 yr after Cl fertilization had been cut. This should lower fertilizer cost and increase margin of profit in farming.

Copra Weight per Nut

Figure 1b shows that the copra weight per nut of palms applied with Cl fertilizers (NaCl, KCl, and NH_4Cl) was all significantly higher (159-221 g/nut) than that of control palms (138-162 g/nut) from 1983-1988 (6 yr). There was no significant difference in the copra weight per nut among Cl sources. In 1982, last year of fertilization, all the three Cl sources significantly increased the copra weight per nut (Cl fertilizers = 200-220 g/nut vs control = 163 g/nut).

The apparent decrease in the copra weight per nut of all treatments in years 1983 and 1986 may be strongly attributed to inadequate rainfall during these years.

It is of interest to note that high copra weight per nut of palms applied with all Cl sources were maintained over the five long years (1983-1987) after fertilization was stopped. This strongly indicates that the Cl nutrient absorbed by the plant remains in its system in adequate Cl levels (0.50%-0.60%) for a long period (at least 5 yr). Moreover, nutrient recycling (fertilizer-soil-plant-soil-plant) could be another strong reason for the long persistency of Cl in the coconut system.

Copra Yield per Tree

In 1982, it was reported that all Cl sources applied significantly increased copra yield of palms over those

of control palms (Magat and Padrones 1982). The positive residual effect on palms in terms of copra yield follows a similar trend as copra weight per nut (Fig. 1b and 1c). Thus, either of the Cl sources when applied regularly for 5 yr maintained high yields of copra for the next 5 yr after Cl fertilization was stopped.

Clearly, the low copra yields of control palms (13-17 kg/tree/yr) were consistent over the years, while palms receiving the 0.80 kg wt/tree, either as 1.78 kg NaCl, 1.82 kg KCl, or 1.60 kg NH_4Cl produced similar copra yields (17-27 kg/tree/yr) from 1983-87. However, at 6 yr from the cutting of Cl application, copra yield of control palms was not significantly different from fertilized palms, indicating the positive residual effects of the earlier fertilization had been over. This condition suggests the need to start re-applying fertilizers for the next 3-5 yr to increase copra yield at high and cost-effective levels.

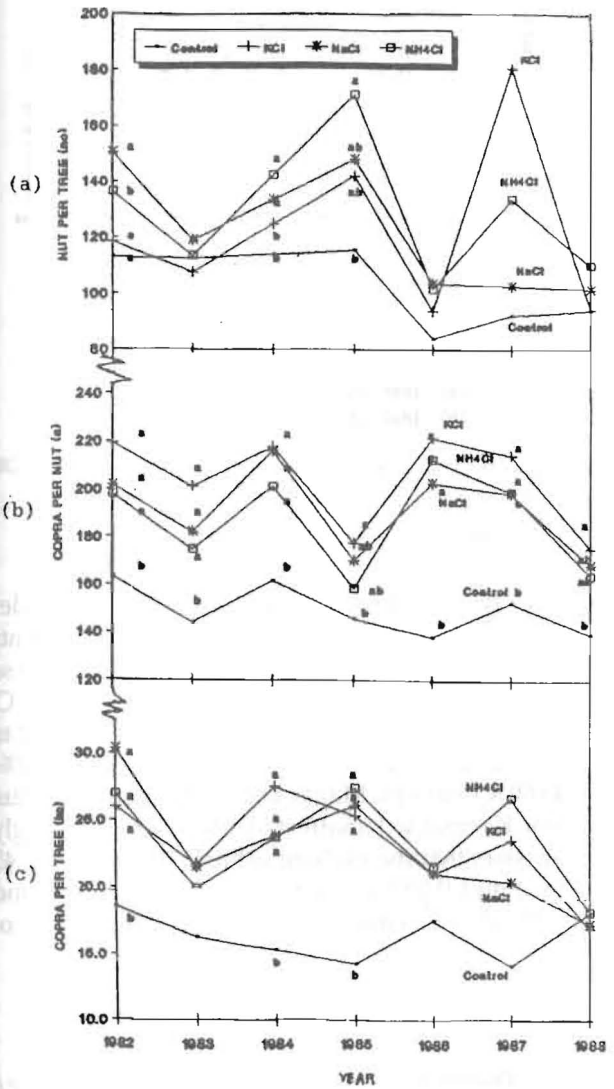

FIGURE 1. Residual effect of Cl fertilizer on
(a) annual nut production per tree;
(b) copra weight per nut; and
(c) annual copra yield per tree

* Final year of fertilization: 1982
Yera w/o fertilization: 1983-1988

Leaf Nutrient Status

(a) Leaf-N

Generally, except for palms receiving 1.60 kg NH_4Cl/tree/yr in 1983 and 1984, leaf-N concentrations of other treatments (control, 1.78 kg. NaCl, and 1.82 kg KCl) are similar (Fig. 2a). This is so as blanket application of 2 kg $(NH_4)_2SO_4$ was received by all experimental palms and as a result, palms with NH_4Cl application received double dosage of N (0.80 kg/tree/yr).

However, leaf-N levels of palms in all Cl treatments, including control palms, had similar levels in later years starting at 3 yr from cutting of fertilizer application. Leaf concentrations in all treatments may be considered above critical levels (1.80%-2.0% N) over the 6 yr that fertilization was stopped.

TABLE 1. Average chemical and physical properties of the inland Tugbok clay loam soil (typic Tropudalfs), PCA-Davao Research Center

PROPERTIES*	SURFACE SOIL (0-17 cm)	SUBSOIL (17-80 cm)
Chemical		
pH (1:1/soil:H_2O)	6.50	6.70
Organic matter%	1.73	1.40
Available P (ppm)	19.00	11.00
Total K (ppm), hot H_2SO_4 extractable	624.00	687.00
Exchangeable cations (meq/100 g soil)		
Ca	11.40	12.30
Mg	5.30	6.40
Na	0.08	0.18
K	0.45	0.29
CEC (m.e/100 g soil)	25.20	26.70
Base saturation (%)	68.30	71.90
Physical		
Textural grade	Clay loam	Clay
% sand	32.90	23.30
% silt	33.30	28.90
% clay	33.90	47.80
Bulk density (g/cc)	1.58	1.45
Total porosity (%)	40.60	45.35
Moisture retention capacity:		
Field capacity (%)	32.60	40.60
Permanent wilting point (%)	17.60	26.70
Available moisture (%)	14.90	13.80

* Bago-Oshiro, Davao City, analyzed by the Bureau of Soils, Davao City.

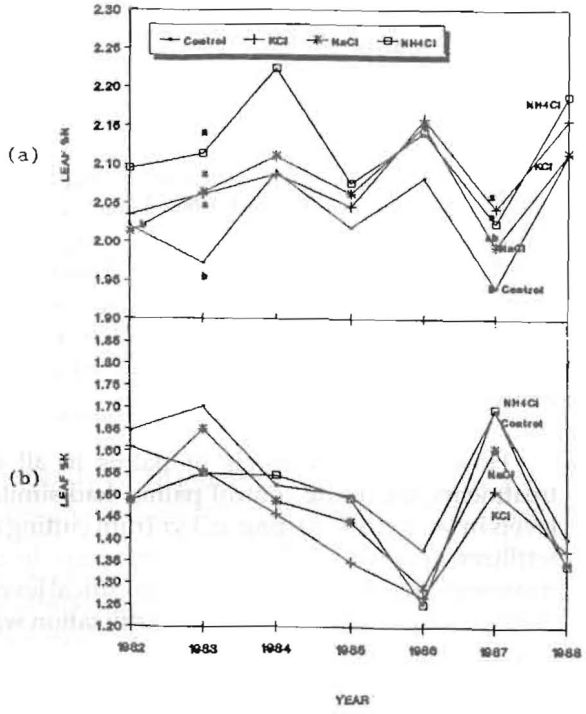

FIGURE 2. Residual effect of Cl fertilizer on
(a) leaf % N (leaf # 14); and
(b) leaf % K (leaf # 14).

* Final year of Cl fertilization: 1982
Yera w/o fertilization: 1983-1988

TABLE 2. Linear correlation (r) of yield indices and leaf nutrient concentrations (leaf #14, 1987 sampling)

NUTRIENT	YIELD INDICES		
	Nuts/tree	Copra/nut	Copra/tree
N	0.60 *	0.59 *	0.77 *
P	0.28 ns	0.22 ns	0.31 ns
K	0.27 ns	0.53 ns	-0.10 ns
Ca	0.24 ns	0.53 ns	0.43 ns
Mg	0.02 ns	0.29 ns	0.14 ns
Na	0.25 ns	0.46 ns	0.42 ns
Cl	0.36 ns	0.89 **	0.70 *
S	0.31 ns	0.10 ns	0.30 ns
B	-0.17 ns	0.58 ns	-0.43 ns

ns - Not significant
* - Significant (p = 0.05)
* - Highly significant (p = 0.01)

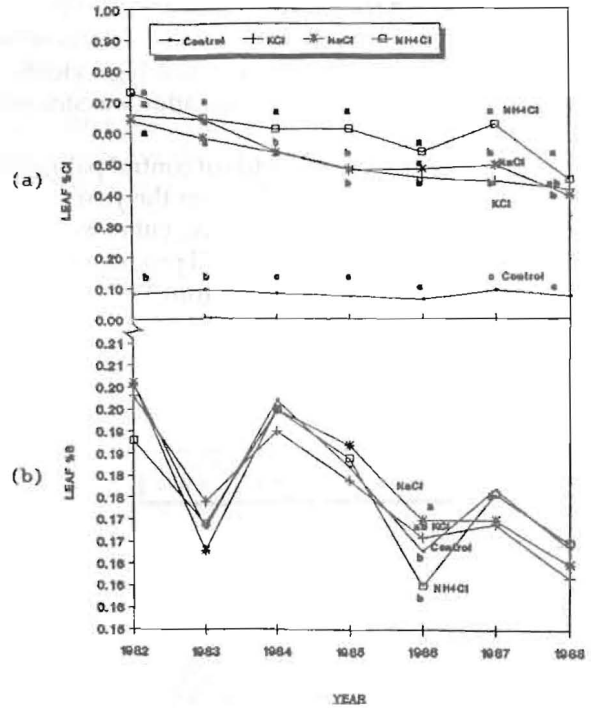

FIGURE 3. Residual effect of Cl fertilizer on
(a) leaf %Cl (leaf #14); and
(b) leaf %S (leaf #14).

* Final year of Cl fertilization: 1982
Years w/o fertilization: 1983-1988

(b) Leaf-K

Over the residual period (1983-1988) under review, leaf-K levels of palms in all treatments were not significantly different (Fig. 2b). This is so even in 1982, year 5 of regular application of Cl fertilizers. Potassium levels of leaves from 1982 to 1988 were all above the optimum levels (0.80%-1.0% K/leaf #14, Magat and Padrones 1991), thus leaf-K remained unaffected. Moreover, it strongly appears that the exchangeable K (Table 1) of 0.45 meq and 0.29 meq per 100 g soil of topsoil and subsoil, respectively, is highly adequate for coconuts.

(c) Leaf-Cl

The application of all Cl fertilizers at 0.80 kg/tree/yr maintained significantly high Cl levels above Cl critical levels of 0.30% (Magat et al. 1989) in treated palms, even at 5-6 yr after the regular fertilization was stopped (1983) (Fig. 3a). In fact, leaf-Cl was within optimum levels of 0.50%-0.60% Cl (Magat et al. 1989), with the application of all Cl fertilizers.

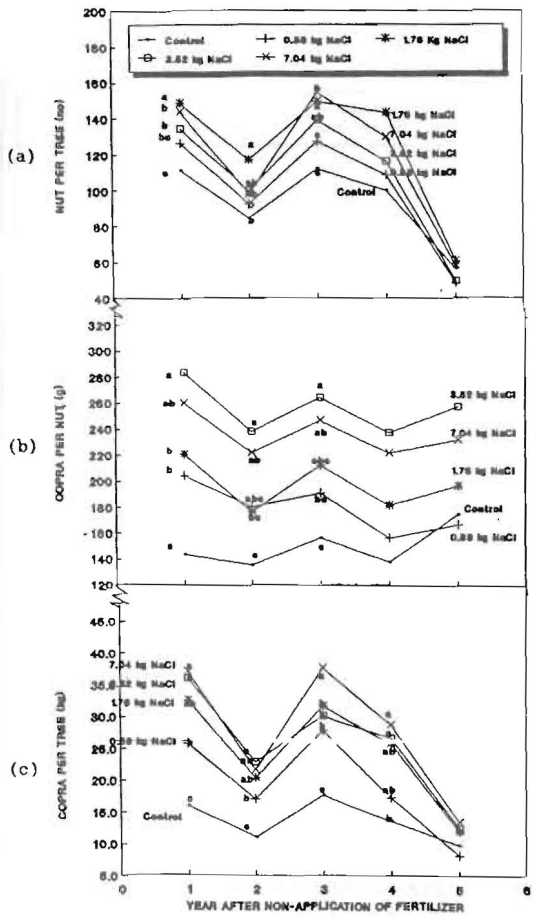

FIGURE 4. **Residual effect of NaCl rates (per tree) on**
(a) annual nut production per tree;
(b) copra weight per nut; and
(c) annual copra yield per tree

TABLE 3. **Soil properties as affected by previous 5-yr NaCl application at increasing rates as observed 5 yr after, February 1991**

NaCl rate (kg/tree/yr)	SOIL PROPERTIES			
	Soil pH		Organic matter (%)	
	Topsoil	Subsoil	Topsoil	Subsoil
0.0	4.96	5.50	2.05	1.28
0.88	5.10	5.50	1.95	1.39
1.76	5.13	5.56	2.01	1.36
3.52	5.20	5.50	1.95	1.22
7.04	5.03	5.43	2.21	1.34
S.E. mean	0.17	0.13	0.16	0.07
C.V. (%)	5.80	4.10	13.40	9.20
	EC (mmhos/cm)		Exchangeable Na (meq/100 g)	
	Topsoil	Subsoil	Topsoil	Subsoil
0.0	0.227	0.203	0.12 ab	0.34
0.88	0.207	0.223	0.08 b	0.23
1.76	0.230	0.230	0.15 ab	0.27
3.52	0.217	0.247	0.30 a	0.39
7.04	0.213	0.257	0.24 ab	0.71
S.E. mean	0.016	0.069	0.04	0.11
C.V. (%)	12.3	9.2	43.0	52.0
	WHC (%)		Bulk density (g/cc)	
	Topsoil	Subsoil	Topsoil	Subsoil
0.0	61.30	64.30	1.48	-
0.88	64.20	65.30	1.51	-
1.76	61.00	64.50	1.43	-
3.52	62.40	66.50	1.41	-
7.04	61.70	66.40	1.50	-
S.E. mean	1.26	1.16	0.03	-
C.V. (%)	3.5	3.1	3.3	-

Clearly, palms without Cl application remained strongly deficient in Cl (0.10% Cl) over the 6 yr observation period. Moreover, the nutrient Cl absorbed by palms from fertilizers applied to soil has a very long persistency in the coconut plant system, resulting to at least 5 yr positive residual effect on coconut; leaf Cl positively correlated with high copra yield (Ollagnier and Ochs 1971; Uexkull 1972; Mendoza and Prudente 1972; Magat et al. 1975; Margate et al. 1979). Recently, Magat et al. (1988) indicated that leaf-N is the main determinant of nut production, while leaf-Cl, the one for copra per nut and copra yield per tree.

(d) Leaf-S

Except in 1984 (2 yr after fertilization stopped), leaf-S levels of palms in all treatments had a decreasing trend, and differences in concentrations of palms applied with Cl did not significantly vary even with control palms (Fig. 3b). As palms (all treatments) received 0.48 kg S (2 kg $(NH_4)_2SO_4$/tree/yr), the leaf-S levels over the 6 yr without fertilization (after 1982) were within the optimum leaf-S levels of 0.17%-0.19% (Magat et al. 1988). This indicates that the regular application of 2 kg $(NH_4)_2SO_4$ from 1979 to 1982 provided palms in all treatments adequate supply of S even after 5 yr the fertilization was stopped (1983-1988).

Correlation of Yield and Leaf Nutrient Concentration

Among the leaf nutrients only leaf-N and leaf-Cl were related with yield indices (Table 2). Leaf-N was significantly correlated with all yield indices (nuts/tree, copra weight/nut, and copra yield/tree), while leaf-Cl had a highly significant correlation with copra weight per nut and significant one on copra yield per tree. This result is consistent with the earlier report of Magat (1988) on the application of NaCl at increasing rates using same Cl-deficient soil of Davao. Several

TABLE 4. Soil properties as affected by previous 5-yr NaCl application at increasing rates, as observed 5 yr after, February 1991

NaCl rate (kg/tree/yr)	SOIL PROPERTIES			
	CEC meq/100 g		Available P ppm (Olsen)	
	Topsoil	Subsoil	Topsoil	Subsoil
0.0	23.80	24.10	20.30	16.60
0.88	24.10	34.70	13.30	11.30
1.76	24.10	25.90	32.60	23.00
3.52	25.50	23.70	15.00	16.00
7.04	23.70	23.50	18.00	14.60
S.E. mean	0.76	3.89	5.40	3.80
C.V. (%)	5.5	25.5	47.8	40.8
	Total K (ppm)		Exchangeable Ca (meq/100 g)	
	Topsoil	Subsoil	Topsoil	Subsoil
0.00	880	746	9.07	9.73
0.88	1053	973	7.76	9.00
1.76	783	686	8.79	10.25
3.52	1116	750	8.37	9.65
7.04	586	1326	7.95	7.51
S.E. mean	267	176	0.83	0.72
C.V. (%)	52	34	17.1	13.9
	Exchangeable Mg (meq/100 g)		Exchangeable K (meq/100 g)	
	Topsoil	Subsoil	Topsoil	Subsoil
0.0	2.05	2.92	2.07	2.33 ab
0.88	2.77	3.31	1.56	0.88 c
1.76	2.24	2.42	1.60	1.45 bc
3.52	2.55	3.08	1.82	1.86 bc
7.04	1.14	1.96	2.69	3.22 a
S.E. mean	0.43	0.63	0.28	0.22
C.V. (%)	34.3	38.1	25.7	19.8

workers in the Philippines had reported positive correlation between copra and leaf-Cl concentrations.

Study II - Residual Effects of Increasing Rates of NaCl (common salt)

Five years earlier, this study revealed that application of NaCl (0.0, 0.88, 1.76, 3.52, and 7.04 kg/tree/yr), corresponding to 0.0, 0.48, 0.97, 1.94, and 3.87 kg Cl/tree/yr, on local tall 'Laguna' coconuts grown on the Cl-deficient Tugbok soil (typic Tropudalfs) increased nut production, copra weight per nut, and copra yield per tree, but not oil content (Magat et al. 1988). Leaf-N (% of dry matter, leaf #14) is the main determinant of nut production while leaf-Cl, the one positively related to and main determinant of copra per nut and copra yield per tree.

Moreover, the study showed that the optimum economic rate was 3.8 kg NaCl/tree/yr (yielding 126

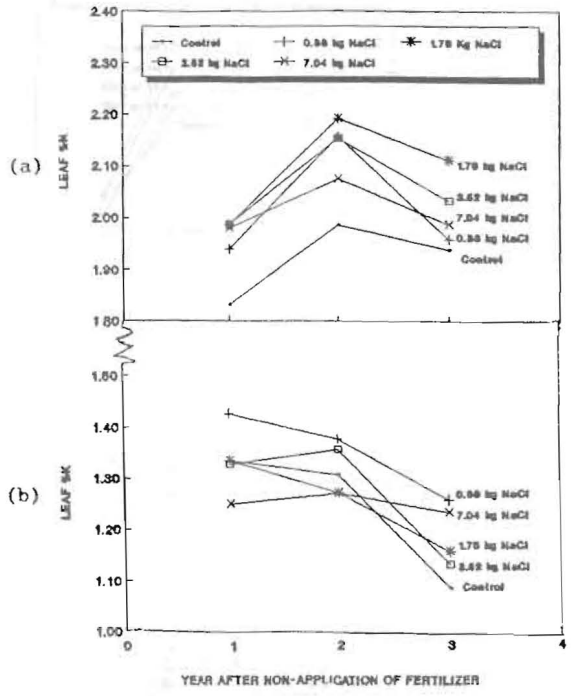

FIGURE 5. Residual effect of NaCl rates (per tree) on (a) leaf %N (leaf #14); and (b) leaf %K (leaf #14).

nuts/tree/yr, 22.6 g copra/nut, and 25.9 kg copra/tree or 112% increase over control palms). It was also noted that even at a low rate of 1 kg NaCl/tree, palms produced about 18 kg copra/tree, while the average yield of farms in the country is about 0.85 ton copra/ha (8 kg/tree/yr).

In the judicious use of common salt (substituting KCl as source of chloride on coconuts), it should be important to understand the residual effects after several years of regular application as basis of a practical and economic fertilizer management.

Nut Production

Generally, nut production of fertilized palms remained at higher levels compared to unfertilized palms (Fig. 4a). However, after 5 yr of non-application of NaCl (even at higher rates 3.52 and 7.04 kg/tree), nut production dropped drastically similar to nut yield of the control palms. This suggests the positive residual effects in terms of nut production last only up to 4 yr after fertilization had been stopped. As N is more positively correlated to nut production than Cl, and thus the former is the main determinant (Magat et al. 1988), the residual effect on nut production may be

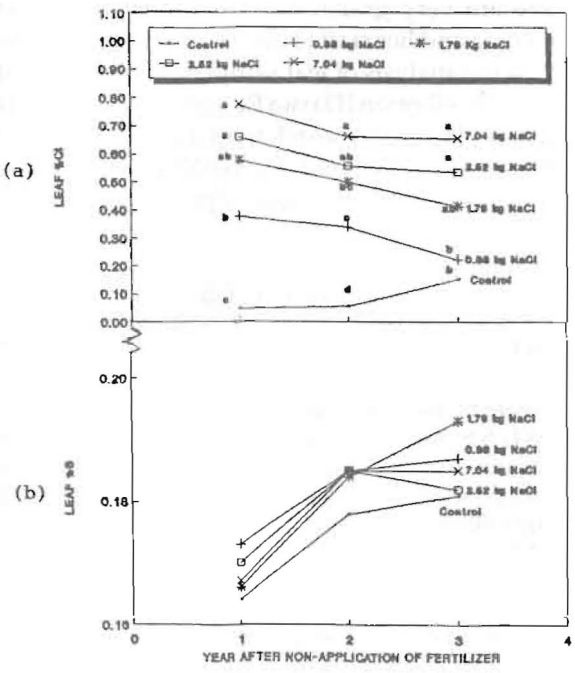

FIGURE 6. **Residual effect of NaCl rates (per tree) on**
(a) leaf %Cl (leaf #14); and
(b) leaf %S (leaf #14).

partially attributed to the blanket application of 2 kg $(NH_4)_2SO_4$ received by palms earlier for 5 yr.

Copra Weight per Nut

Figure 4b shows that even for 5 yr of non-application of NaCl fertilizers, palms applied with higher rates of NaCl (1.76-7.04 kg/tree) apparently maintained higher copra weight per nut (220-260 g/nut) compared to the control palms (140-170 g/nut). This result indicates that longer positive residual effects on copra weigh per nut takes place (5 yr at least), especially at higher rates (> = 1.76 kg NaCl/tree), consistent with findings in Study I presented earlier.

Copra Yield

High levels of copra yields, particularly for high rates of NaCl (> = 1.76 kg/tree) were maintained up to 4 yr of non-application of fertilizers (Fig. 4c). Control palms consistently produced the lowest copra yields, however, at 5 yr after fertilization was stopped, yields of these palms were not significantly different from the NaCl-applied palms.

As copra yield/tree is a function of both nut production and copra/nut, the decline in nut productiono during the fifth year (Fig. 4c) affected copra yield, even if copra weight per nut still remained high (especially at high NaCl rates). It therefore appears that the clear positive residual effects of NaCl application are stronger at higher rates of fertilization and tend to persist up to 5 yr after the cut in the regular NaCl fertilization

Leaf Nutrient Status

Although concentrations of N, K, and S in coconut leaves (leaf #14) at 1, 2, and 3 yr after NaCl fertilization was stopped were lower in the control palms (no previous NaCl applied), these levels were not significantly different from those applied with NaCl (0.88-7.04 kg/tree) as shown in Figures 5a, 5b, and 6b. Leaf N, K, and S in these years were all above the critical levels (1.8% N, 0.8% K, and 0.12% S) in all treatments including control palms. This suggests that the previous blanket-application (5 yr) of 2 kg $(NH_4)_2SO_4$ had maintained adequate levels of N and S; and the Tugbok soil used had adequate supply of K (0.45 meq ha/100 g soil) for high yields.

However, leaf-Cl of palms applied previously (for 3 yr) with high rates of NaCl (1.76, 3.52, and 7.04 kg/tree) was within the optimum levels of Cl (0.50%-0.60%) (Fig. 6a). The low level of leaf-Cl in control palms (0.08%-0.15%) and palms receiving only 0.80 kg NaCl (especially at the third year) were below the critical level (0.30%). These resulted in very low copra weight per nut and copra yield of palm as mentioned earlier. At higher rates of NaCl (1.76-7.04 kg/tree), longer positive residual effects were reached mainly due to higher concentrations of leaf-Cl maintained by palms, associated with significantly higher copra weight (per nut) and copra yield (per tree).

Some Soil Properties

Five years after the NaCl fertilization cut, soil properties (topsoil and subsoil) as pH, organic matter, electrical conductivity, waterholding capacity, CEC, available P, total K, exchangeable bases (Ca, Mg, and K) were not significantly different from the control, even in trees applied with high rates of NaCl (3.52 kg and 7.04 kg/tree/yr) (Tables 3 and 4). However, for soil Na, especially at the two higher rates, levels remained still high, but the soil bulk density did not significantly vary, indicating that the rates applied of NaCl (0.88-7.04 kg/tree) did not result in destruction of soil structure as reflected through the bulk density (1.41-1.51 g/cc) (Table 3).

The levels of salinity and Na as indicated by electrical conductivity (EC) and exchangeable Na are considered way below the critical or excessive levels of EC 40 mmhos/cm and > 0.50 Na meq/100 g soil.

The clear increase in soil acidity (decreased pH) in all treatments including the control was likely due to the earlier application (5 yr) of 2 kg $(NH_4)_2SO_4$. At pH 5, coconut still grows and produces normally. Moreover, it strongly appears that soil P and exchangeable bases (K, Ca, Mg) are still highly adequate for the palms.

CONCLUSION

Results indicate for the first time clear evidence of the positive residual effects of Cl bearing fertilizers on the yield indices of coconuts. In terms of nut production, copra weight per nut, and copra yield per tree, findings of these long-term studies (sources of Cl: KCl, NaCl, and NH_4Cl; NaCl rates: 0.0, 0.88, 1.76, 3.52, and 7.04 kg/tree/yr) apparently showed that for every 5 yr of regular Cl fertilization (0.80 kg Cl) the application of Cl fertilizers (and even N and S fertilizers) is not required for at least the next 3 yr as production of nuts and copra is maintained at high levels. This is mainly attributed to the residual effects as a result of the concentration of Cl in the crop at optimum levels (0.50%-0.60%) or above critical levels (0.30% Cl) of leaf-Cl. This is likely applicable in areas deficient in Cl (< = 0.30% Cl, leaf #14), with soils adequate in N, S, and K, or soils fertilized with $(NH_4)_2SO_4$.

With NaCl application, the positive residual effects on copra (weight/nut and yield/tree/yr) could last for a longer period (4-5 yr) at fertilization rates of > = 1.76 kg NaCl/tree (0.97-3.87 kg Cl/tree/yr).

Based on the soil bulk density, exchangeable Na and salinity index (EC), even at higher NaCl rates (3.52 kg and 7.04 kg/tree), no apparent adverse effects are observed. The maintenance or persistence of beneficially high levels of leaf-Cl in coconuts as a result of the previous application could either or both be likely due to nutrient recycling within the soil and crop systems, common in long-term cropping or production of perennials.

In the rehabilitation of existing stands of coconut or newly established farms, findings of this study on the existence of positive residual effects of fertilization particularly application of Cl fertilizers (as NaCl, KCl, and NH_4Cl) implies that with 3-5 yr of regular fertilization, the next 3-5 yr very likely requires no fertilization at all due to the build-up of nutrients within the plant system, physiologically and agronomically speaking. Because of the savings from non-fertilization, higher benefit-cost ratio or margin of profit should be expected, considering also that high nut and copra yields are maintained due to the positive residual effects of Cl fertilizers.

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