EXTENSION PUBLICATIONS

UNIVERSITY of HAWAI'I at MĀNOA
COLLEGE OF TROPICAL AGRICULTURE AND HUMAN RESILIENCE

Salt Fertilization for Coconut Palms in Hawai‘i

Research-Based Recommendations

At a Glance: Coconut palms can require salt (sodium chloride) as a fertilizer to support plant health and improve nut production. Young plants, as well as plants grown inland or upland, are at increased risk for chloride deficiency. This publication from the University of Hawai‘i at Mānoa's College of Tropical Agriculture and Human Resilience advises Hawai‘i growers on how to use salt as a fertilizer for coconut palms, emphasizing research findings from plantings on volcanic soils.

Figure 1. A coconut palm frond showing symptoms of chlorine deficiency, with leaflets turning from green to yellow. Photo: Alex Smolak, Malama Sanctuary

Introduction

Coconut palm (*Cocos nucifera* L.) productivity can be significantly enhanced through proper nutrient management. This publication presents research-based recommendations for the use of common salt (sodium chloride, NaCl) as a locally available fertilizer to address chloride deficiency in coconut palms grown in Hawai‘i—a nutrient issue often overlooked but essential for optimal palm health and yield.

In particular, research from volcanic zones in Papua New Guinea (PNG) has shown that even plantations as close as 100 m from the ocean may suffer from chlorine deficiency, suggesting that ocean spray alone may be insufficient in some environments (Ollivier et al. 1999). This finding is relevant for Hawai‘i, where volcanic soils may share similar characteristics.

The Science: Chloride as a Beneficial Micronutrient

Chloride is an essential micronutrient involved in osmo-regulation, stomatal function, and enzyme activation. Chloride deficiencies (Figure 1 and Box 1) have been documented in inland and upland coconut plantations in tropical regions (Magat et al. 1992; Mathew et al. 1984; Malhotra et al. 2017; Wijebandara 2010).

Field studies from the Philippines and India report that sodium chloride applications can increase coconut yield by 30–50% compared to untreated controls. Treated palms

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Box 1. Chloride Deficiency Symptoms

- Reduced growth rate of plant
- Reduced number of fronds
- Premature yellowing and senescence of older fronds
- Reduced frond size and canopy density
- Fewer nuts, smaller nut size, and lower copra content
- Restricted root growth with club-shaped laterals Increased vulnerability to leaf spot diseases

Chloride deficiency should be strongly suspected when multiple symptoms occur simultaneously, especially in inland or high rainfall areas.

show improved nut set, nut size, and leaf development (Magat et al. 1992; Margate et al. 1988). Similar benefits were observed in PNG, where salt applications significantly improved growth, precocity, and early production, including for plantations close to the ocean (Ollivier et al. 1999).

In addition to PNG studies, further evidence comes from Indonesia, where NaCl fertilization has been shown to strongly improve coconut growth, yield, nut size, and resistance to water stress across various soil types (Bonneau et al. 1997). Trials in Gunung Batin, Indonesia, 70 km inland, demonstrated that chlorine was the dominant nutritional factor for both young and mature coconut palms, and that foliar chlorine levels were more strongly correlated with yield than potassium. Fertilization with NaCl has been shown to significantly increase tolerance to drought in coconut palms, improving survival, and stabilizing production under water-limited conditions. Beyond this key benefit, NaCl also allows partial substitution of potassium chloride (KCl), offering both agronomic and economic advantages. This is particularly relevant for Hawai‘i, where volcanic and ferrallitic soils can share similarities with those studied in PNG and Indonesia, suggesting that chlorine nutrition should be an important consideration for both young and mature palms, especially for palms under dry-season stress.

Research from PNG further highlights that young palms, even when grown close to the ocean, may not access chloride from saline water tables, unlike older palms with deeper root systems. As such, supplemental chloride is essential for young or replanted palms during their initial years (Ollivier et al. 2001).

Application Recommendations

Before applying salt, consider:

- **Proximity to ocean:** Palms within 50–100 m (160–325 feet) of the coast often receive chloride through ocean spray. However, studies from volcanic soils in PNG show that this contribution may be negligible in some environments (Ollivier et al. 1999), highlighting the need for site-specific evaluation in Hawai‘i.
- **Soil type:** Sandy and coral-based soils common in Hawai‘i are typically low in both chloride and potassium (Mathew et al. 1984).
- **Symptoms:** Visual signs of deficiency can help guide early treatment.
- **Tissue testing:** The youngest fully open frond should contain 0.5–0.7% chloride (dry weight) (Magat et al. 1989; Magat et al. 1992).
- **Irrigation water:** check potential irrigation water’s sodium and chlorine levels to possibly adjust application rate

Application Methods

Choose the method best suited to your site:

1. **Broadcast:** Spread NaCl evenly in a 3-foot (1-meter) radius around the trunk. Apply during or just before light rain.
2. **Broadcast and fork-in:** Lightly mix salt into the upper 2 to 3 inches (5 to 7.5 cm) of soil using a hoe or rake to reduce runoff. Recommended when NaCl is applied with N or K fertilizers.
3. **Holing:** Dig 8–10 shallow holes (3–5 inches [7.5–13 cm] deep) around the tree base, apply salt directly, and cover with soil. Ideal for sloped terrain (Magat et al. 1992)

Application Rates

The salt application rates in Table 1 have been shown to increase yield. Note that excess salt can disrupt the soil’s nutrient balance (Mathew et al. 1984).

Table 1. Salt Application Rate by Palm Age

Palm Age	Recommended NaCl ounces (grams)
<1 year	2 (50)
1 year	18 (500)
2 years	26 (750)
3 years	39 (1,100)
4 years	46 (1,300)
5+ years	53 (1,500)

Adapted from Philippine Coconut Authority (2019).

Timing and Frequency

- In consistently rainy areas, apply once annually.
- In areas with distinct wet/dry seasons, divide the dose every six months.
- For young palms (1–4 years), always divide the dose.
- The ideal time to apply is the start of the rainy season.

Economic Benefits

Southeast Asian trials show that salt fertilization can more than triple yields in chloride-deficient soils (Table 2 and Magat et al. 1992). Similar results were reported in PNG, where both flowering precocity and nut yield were significantly improved under chloride supplementation (Ollivier et al. 1999).

At typical market prices, the return on investment exceeds 10:1 (Magat et al. 1992).

Nutrient Interactions and Cautions

- **Potassium:** Sodium (Na^+) can compete with potassium (K^+) uptake. On low-K soils, apply KCl with NaCl (Prema et al. 1992). Symptoms of potassium deficiency first appear on older leaves as translucent yellow or orange spots near the leaf tips, and later necrotic areas along the leaflet margins.
- **Boron:** High salt rates (NaCl) may reduce boron availability. Monitor for symptoms that includes small chlorotic spots on young leaves and, later, severely deformed leaves and a failure of new leaves to unfurl.
- **Integrated nutrient management:** Combine NaCl with full fertilization programs for best results (Magat et al. 1992).
- **Palm age:** As observed in PNG, young palms require chloride supplementation even near the ocean, while older palms may access saline water tables (Ollivier et al. 2001).

Environmental Considerations in Hawai'i

- Chloride levels are affected by wind shadows, rainfall variability, and leaching.
- High rainfall areas may require split or higher application rates.
- Avoid use near streams, wetlands, or other sensitive ecosystems.

Table 2. Impact of Salt Fertilization on Copra Yield

Salt Rate lb/tree (g/tree)	Copra Yield lb/acre (kg/ha)
None	757 (850)
2.2 (1,000)	1,781 (2,000)
3.3 (1,500)	2,226 (2,500)
4.4 (2,000)	2,500 (2,750)

Adapted from Philippine Coconut Authority (2019). .

Conclusion

Sodium chloride is a proven, low-cost input for boosting coconut yields, particularly in inland or upland areas where natural chloride inputs are lacking. Findings from Papua New Guinea show that even palms near the ocean can suffer from chlorine deficiency, particularly during early growth, making supplemental chloride essential for both inland and coastal plantings in Hawai'i. By following these research-based guidelines, growers can improve productivity while maintaining long-term soil and crop health.

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