



# Nematode Community Analysis as an Indicator to Examine the Effects of Korean Natural Farming on Soil Health

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## Abstract

Two on-farm studies were conducted to evaluate the effects of Korean Natural Farming (KNF) on soil health using nematode community analysis. The first objective was to determine if soil health conditions would improve over time after the introduction of indigenous microorganisms (IMO) into taro (*Colocasia esculenta*) fields. Soil samples were taken from six field sites of a KNF farmer at 0 (fallowing), 1, 2, 4, 6, and 12 months after IMO application. Numbers and percentages of nematode trophic groups, nematode diversity and richness, and various nematode indices were used as soil health indicators. All IMO treated plots improved soil health conditions when compared to 0 months, but there were no trends of improvement of soil health over time. The second objective was to compare soil conditions between KNF and certified organic farming in corn (*Zea mays*) fields. Soil samples were taken from fields treated with IMO, organic fertilizer, and IMO plus organic fertilizer. Soil health conditions were not different between IMO and organic treatments, suggesting that IMO could replace organic fertilizer. Future research in a controlled greenhouse environment is needed to further evaluate the effects of KNF in vegetable production.

## Introduction

Korean Natural Farming (KNF) is an agriculture practice meant to minimize chemical inputs while promoting the functions of indigenous microorganisms (Park and DuPonte, 2010). Most recently, KNF practice is becoming more interesting to farmers in Hawaii due to rising fuel cost. To date, scientific documentation on the benefits of KNF in crop production is still lacking. It has been hypothesized that the application of indigenous microorganisms (IMO) prepared according to KNF could improve soil health conditions. Nematodes have been proven to be good soil health indicators (Wang and McSorley, 2005), and thus were used to access the effect of KNF.

Specific objectives of this research were to examine if KNF

- 1)improved soil health conditions over time, and
- 2)improved soil health conditions more than standard organic farming.

## Materials & Methods

### Experiment I – Improvement of soil health over time

Soil samples were taken from a KNF-practicing taro (*Colocasia esculenta*) farm in Waianae, Oahu. Six field sites were sampled at 0 (fallowing), 1, 2, 4, 6, and 12 months after IMO application prior to taro huli planting. Three to four replication samples were collected from each site.

Table 1. Dynamic of nematode community indices from 1 to 12 months after IMO treatment in taro fields.

Indices	Months after IMO Treatment					
	0	1	2	4	6	12
% bacterivores	42.77 c	62.8 b	79.13 a	55.1 b	76.84 a	72.26 a
% fungivores	7.13 c	20.1 ab	17.52 abc	25.27 a	9.53 bc	19.89 ab
% herbivores	46.04 a	13.19 b	0.71 c	15.83 b	10.36 b	4.47 bc
% omnivores	3.33	3.41	2.64	2.27	1.84	1.28
% predators	0	0	0	0.96	0.22	0
Richness	16 ab	11.5 ab	11.67ab	11 ab	17.67 a	10.5 b
Diversity	3.96 b	5.26 ab	5.44 ab	7.16 a	4.38 ab	5.82 ab
EI <sup>z</sup>	43.17 b	77.26 a	49.2 b	51.54 b	84.17 a	68.33 a
SI	25.01 ab	24.74 ab	23.34 ab	16.84 ab	46.99 a	9.41 b
CI	19.85 b	13.38 bc	23.08 ab	41.06 a	5.53 c	16.48 b

Fig. 1. Dynamic of enrichment index (EI), structure index (SI), and channel index (CI) in IMO treated soil at 0 to 12 months after taro planting.

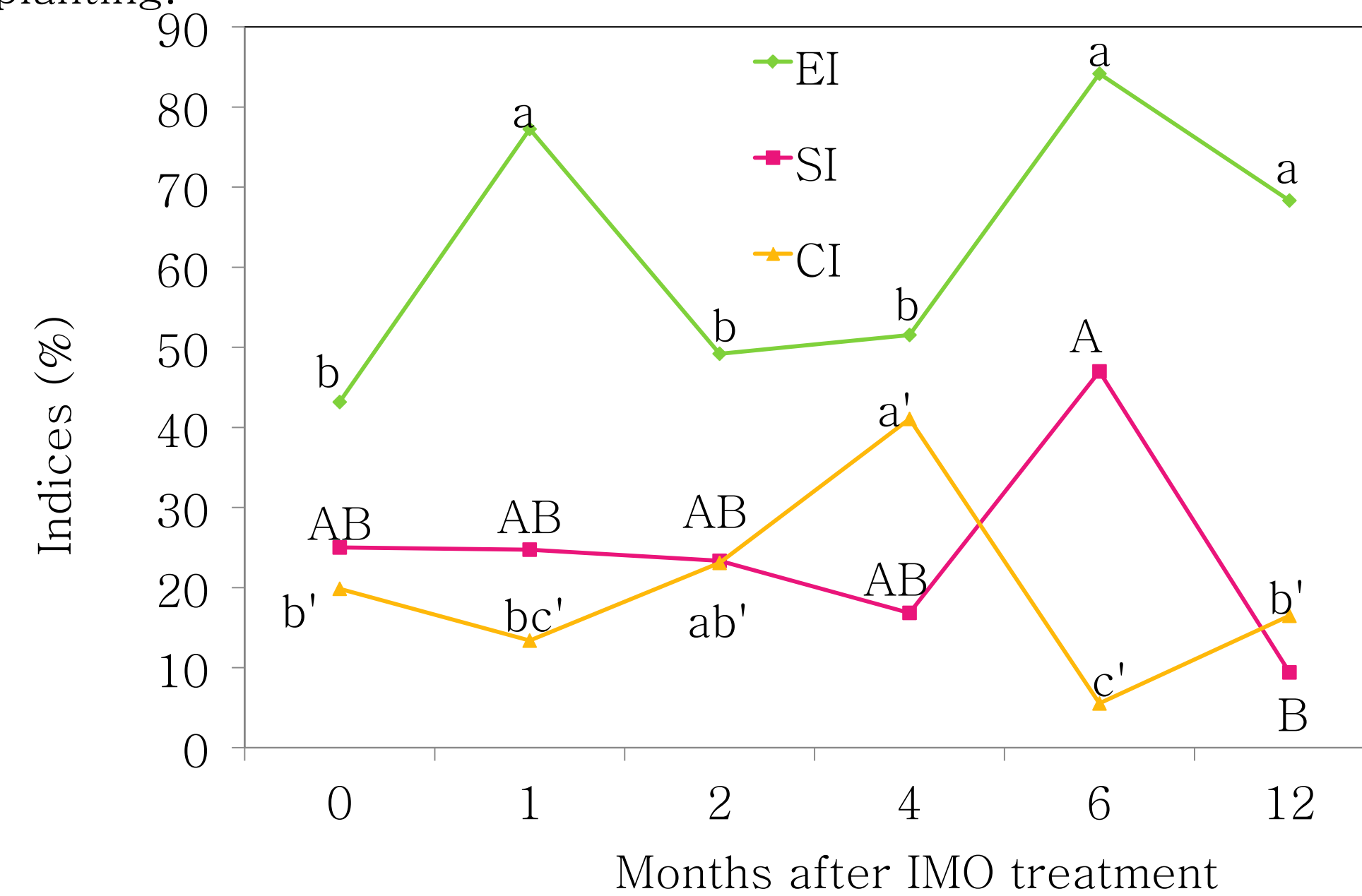


Table 2. Nematode richness, diversity, enrichment index (EI), structure index (SI), and channel index (CI) at 3 months after corn planting in field plots that received with IMO, organic fertilizer or combination of IMO and organic fertilizer.

Indices	IMO	Organic Fertilizer	IMO + Organic Fertilizer
Richness	12	14	12
Diversity	2.11	3.79	1.52
EI	54.53	64.27	59.60
SI	46.05	64.23	40.06
CI	31.00	25.97	37.44

## Materials & Methods Continued

### Experiment II – Compared to organic farming

Soil samples were collected from 3-month old corn (*Zea mays*) fields that were treated with IMO, organic fertilizer, and IMO plus organic fertilizer prior to corn planting. Organic fertilizer treatment followed the commercial organic farming practice with bone meal and chicken manure.

### Nematode Assay

Nematodes were extracted from 250 cm<sup>3</sup> soil per sample by elutriation and centrifugal floatation. All nematodes extracted were identified to genus level, counted, and grouped into trophic groups (bacterivorous, fungivorous, herbivorous, omnivorous, and predatory). Nematode diversity, richness (Neher, 2001), Enrichment Index (EI), Structure Index (SI), and Channel Index (CI) were calculated (Ferris et al., 2001). Data were subjected to one-way analysis of variance and means were separated by Waller-Duncan k-ratio (k=100) t-test.

## Results and Discussion

### Experiment I

- IMO treatment increased % bacterivores over time, but it did not affect % omnivores or % predators.
- IMO treatment did not increase richness and diversity over time.
- IMO treatment increased EI over time, indicating that the soil was enriched in nutrients.
- IMO treatment increased SI up to 6 months after planting, but SI was decreased at 12 months after planting, indicating that IMO did not inhibit soil disturbance. This might have been due to tilling by the farmer.
- IMO treatment did reduce CI at 6 months after treatment, indicating a less stressful condition, but this condition did not last through 12 months after treatment (Table 1, Fig. 1).
- Overall, this nematode community analysis suggested that IMO maintained soil nutrient enrichment, but soil communities were still disturbed due to conventional tillage.

### Experiment II

- Soil health conditions were not different between IMO and organic treatments (Table 2), suggesting that IMO could replace organic fertilizer.

## Summary

Based on Experiment I, continuous application of KNF inputs improved soil health conditions up to 6 months after IMO treatment, but these conditions did not last to 12 months after treatment. This is most likely because the farmer tilled the soil to replant taro prior to the 12-month sampling. Based on Experiment II, applying IMO could enrich soil health conditions similarly to organic farming methods in corn production. Future research is needed to obtain plant growth data along with nematode community analysis.

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