69-3A75-14-231

CRATE

USDA NRCS

PROMOTING THE USE OF COVER CROP CALCULATOR FOR THE TROPICS AS NITROGEN MANAGEMENT

Project Summary: In 2014, scientists and Extension Agents from University of Hawaii College of Tropical Agriculture and Human Resources in collaboration with Oregon State University received a Natural Resources Conservation Service (NRCS) Conservation Innovation Grant to develop a Cover Crop Calculator for Hawaii as well as Norther Mariana Islands to help farmers estimate nitrogen made available from growing cover crops. The goal is to provide farmers a tool to estimate how much nitrogen fertilizer to cut back. The project also educated and demonstrated farmers about the benefits of cover cropping and soil health management.

The project is completed in Aug 2018. A cover crop calculator for Hawaii specific to 10 key agriculture production sites were generated and is available for download at https://cms.ctahr.hawaii.edu/wangkh/ResearchandExtension/CoverCrops.aspx labeled as Cover Crop Calculator (excel file). Self-guiding instruction on how to use the calculator is available on the first tab of this excel file or at http://www.ctahr.hawaii.edu/WangKH/Downloads/Instructions-covercrop -%20calculator.pdf.

5	Follow instruction in Sheet #1 to fill in cells in **Step 2**. Best time to terminate an annual cover crop in Hawaii is about 2-3 months after planting.													
6	Date: 3/13/2017			2. Enter your information in white cells				3. Results are in the orange cells						
7	1. Use row with your location and soil order													
8	Location and soil			Your sample info.				Dry wt. & total N			28 Day PAN		70 Day PAN	
9	Island	Location	Soil Order	Area sampled (ft^2)	Fresh wt of field sample (x.xlbs)	Total % N from lab (x.x%)	% dry matter from lab (xx.x%)	Fraction of acre sampled	Dry Weight (lb/Acre)	Total N (lb/A)	PAN (%)	Actual PAN (lb/A)	PAN (%)2	Actual PAN (lb/A)
10	Oahu	Poamoho	Oxisols	1	1.20	2.00	23.00	0.00002	12023	240	58.2	140	70.1	168
11	Oahu	Waimanalo	Mollisols					0.00000	0	0	0.0	0	0.0	0
12	Oahu	Kunia	Oxisols					0.00000	0	0	0.0	0	0.0	0
13	Hawaii	Waimea	Andisols	1	1.20	2.00	23.00	0.00002	12023	240	34.3	82	41.7	100
14	Maui	Alae	Andisols					0.00000	0	0	0.0	0	0.0	0
15	Maui	Kula	Andisols					0.00000	0	0	0.0	0	0.0	0
16	Maui	Waiakoa	Mollisols					0.00000	0	0	0.0	0	0.0	0
17	Molokai	Hoolehua	Inceptisols					0.00000	0	0	0.0	0	0.0	0

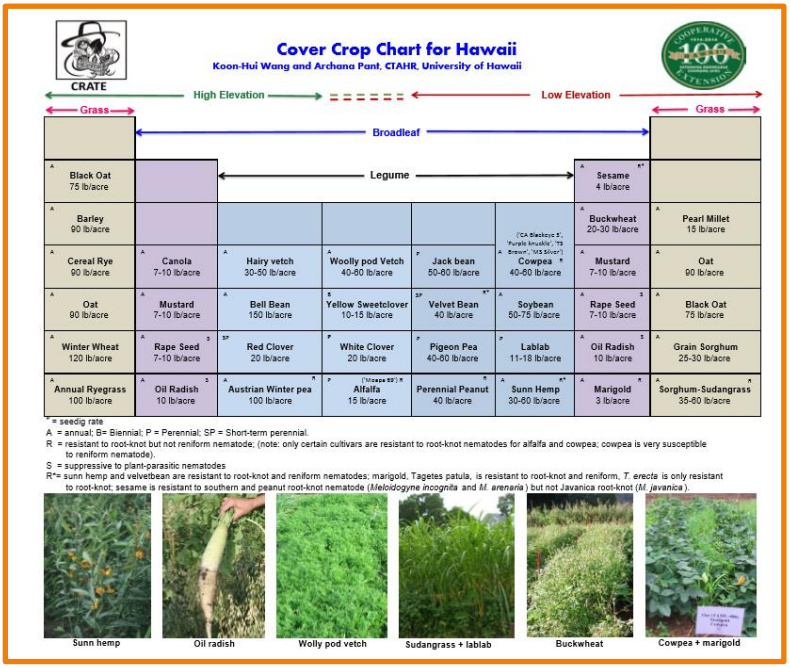
The PIs of this project along with their collaborators from Oregon State University have since conducted 35 workshops or field days to demonstrate the use of Cover Crop Calculator throughout the 5 islands in Hawaii in the last four years. Eleven conference presentations within the state or nationally had been presented to share our findings on using cover crops for nitrogen or soil health management. Four extension articles were published to promote the use of Cover Crop Calculator to reduce fertilizer use, while introducing the benefits of Conservation Agriculture (Cover cropping + conservation tillage + crop rotation). We summarized “Relationships between cover crop plant-available nitrogen mineralization rate and nematode soil health indicators” and presented at a national conference of the Society of Nematologists as well as at the Soil and Water Conservation Society (SWCS) Conference in 2016. One peer reviewed article was published, another one was submitted in 2018 related to the use of cover crop for soil health management. One M.S. student completed his thesis working on Conservation Agriculture on Soil Health Management.

Products delivered:

Cover Crop Calculator to estimate Plant Available Nitrogen (PAN) from Cover cropping

Cover crop Chart for Hawaii

Factoring soil health indicators into PAN prediction model



- We created a website to populate our findings related to cover crop projects at http://www.ctahr.hawaii.edu/WangKH/cover-crop.html.
- We upload pictures from our outreach activities to CTAHR Center of Rural Agricultural Training and Entrepreneurship website at http://www.ctahr.hawaii.edu/WangKH/CRATE.html
- A list of cover crop mix for different purposes such as insectary or soil builder that are appropriate for Hawaii and the Pacific Islanders: http://www.ctahr.hawaii.edu/WangKH/Downloads/Insectary_Cover_Crop_Mix.pdf

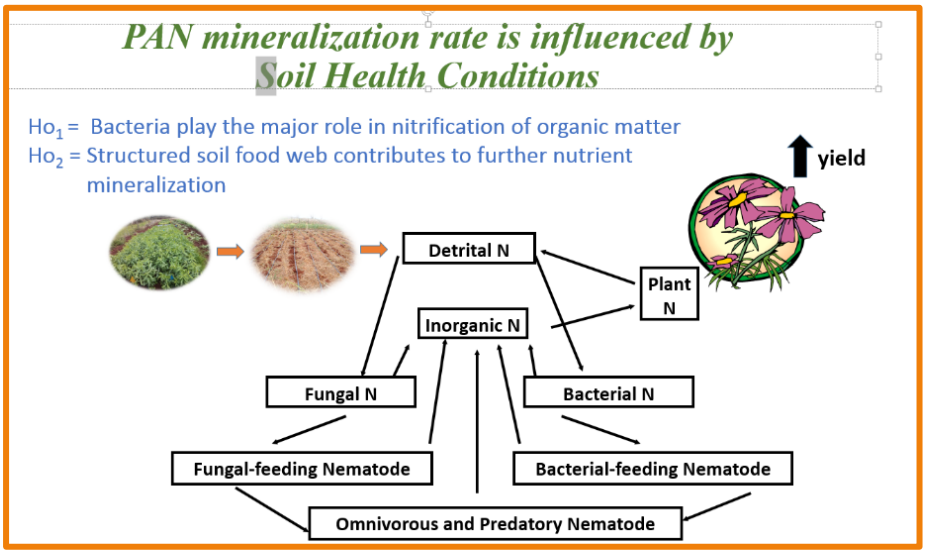
Process

Eleven cover crop trials were conducted across the State where PAN mineralization rates (28 days after incubation) of several cover crops at each locations (involving four common soil types in Hawaii, i.e. Andisol, Inceptisol, Mollisol and Oxisol with different soil health conditions) were assayed, and their relationships with soil health conditions using nematodes as soil health indicators were depicted in a canonical corresponding analysis. It becomes evident that PAN mineralization rates of cover crops residues were strongly affected by the structure of the soil food web, i.e. the more structured the soil food web, the faster the PAN mineralization rates. We shared this information with local farmers to provide more incentives for farmers to manage soil health. None-the-less, prediction model for PAN% by location based on tissue N % (current cover crop calculator) still provide better prediction than combining data from multiple locations.

Outcomes/Impacts

- Based on our 4-day Cover Crop Calculator week state-wide outreach event, farmers rated in a scale of 1-5, an average of 4.7 in terms of willing to incorporate Cover Crop Calculator into their fertilizer management program to reduce nitrogen fertilizer use.

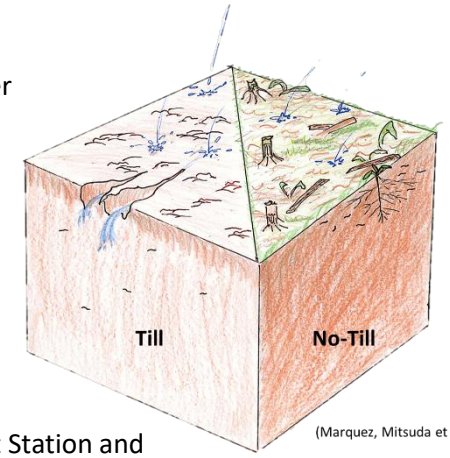
- Planting of cover crops in between cropping cycles scavenge access nutrients applied from last cropping cycle, reduce nutrient leach into ground water, improve soil health that lead to better water quality conservation.



Key Findings

Unlike the original findings from Kansas that found strong correlation between PAN released rate with nitrogen content in cover crop tissues, we find PAN released rate of cover crops is affected strongly by soil health conditions besides nitrogen content of the cover crops. This is due to a high diversities of microclimates, soil types, and soil management practices in Hawaii. None-the-less, as long as soil health condition does not change significantly, estimation of PAN released rate of cover crops based on % N of the tissues still provide better prediction of PAN by location. However, it is recommended that farmers check the performance of Cover Crop Calculator at their field site over time as PAN releasing rate might increase as the soil health improved over time.

Outreach



(Marquez, Mitsuda et al., 2016)

We were invited by several organizations to high light the benefits of cover cropping particularly for soil health management. These include Hawaii Farmers' Union United (HFUU) during their State Convention in Wailuku, Maui; NRCS Pacific Islands Area (PIA) at a one-day cover crop training workshop at the Plant Material Center, Hoolehua, Molokai; Monsanto Seed Corn Industry Hawaii invited us to determine PAN % specifically for their farm sites. For the last 4 years, we periodically provide guest lectures for new farmers training programs about ***"Cover Crop and Soil Health Management"*** lectures at multiple locations throughout the state, these include GoFarm Hawaii New Farmer's training program at Winward Community College, Leeward Community College, Waimanalo Experiment Station and NorthShore Pioneer on Oahu; Kauai Community College on Kauai, Honokaa on Hawaii Island; The Kohala Center Beginning Farmers' Training program in Honokaa, and Pacific Gareway Immigrant Farmers training program. Using the demonstration trials established from this project, we provided active outdoor training classrooms for frequent visits from multiple groups including College of Tropical Agriculture (CTAHR) Cooperative Extension Events, undergraduate classes (PEPS 410-Plant and Soil Health Management), PEPS 481 (Weed Sciences) etc. We also established a Center of Rural Agriculture Training and Entrepreneurship (CRATE) program that focused on

providing scientific based information about sustainable agricultural practices for small- and mid-size farms in Hawaii.

Center of Rural Agricultural Training and Entrepreneurship
https://cms.ctahr.hawaii.edu/wangkh/ResearchandExtension/CRATE.aspx

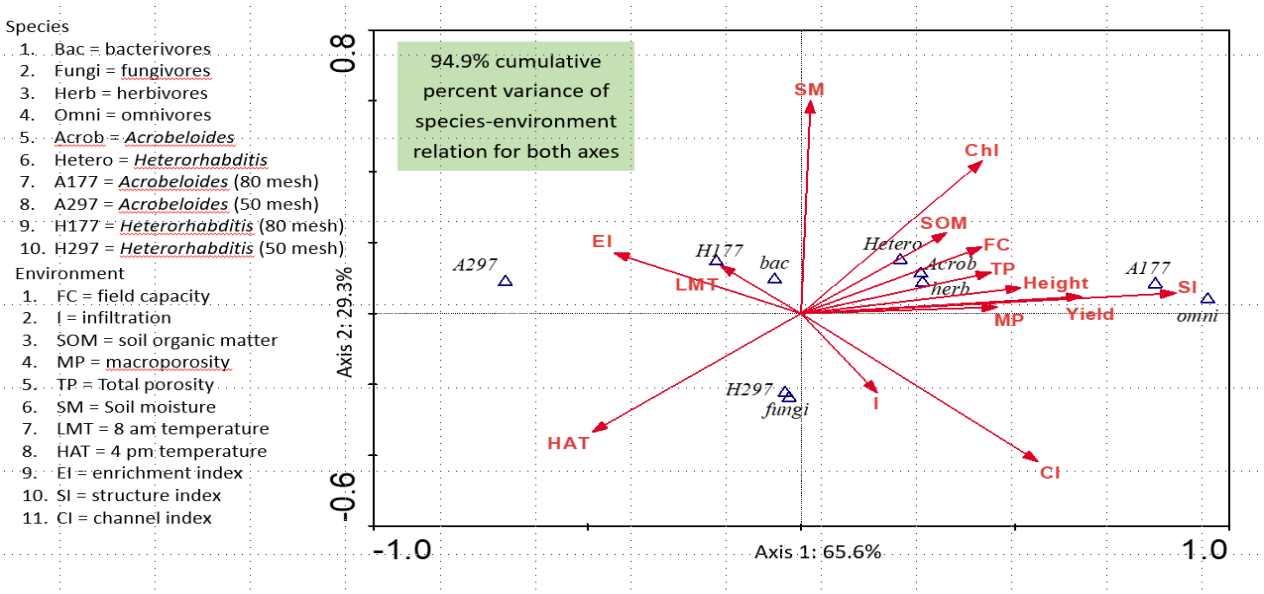
CRATE

Work Featured in Public Media

- Howard Dicus. 2015. Hawaii News Now: Soil slaking and infiltration tests: http://www.hawaiinewsnow.com/story/27943343/take-advantage-of-the-upcoming-free-workshops-on-soil-health-awareness
- CTAHR Office of Communication Service. 2015. Not Just Dirt. CTAHR Impact Stories. http://www.ctahr.hawaii.edu/site/StoryDetails.aspx?id=1694 (8/20/15)
- CTAHR Dean & Director for Research and Cooperative Extension. 2015. Not Just Dirt. Pp. 6 in CTAHR 2015 Second Quarter Impact Report. http://www.ctahr.hawaii.edu/oc/impact/impact15q2.pdf
- Our Cover Crop Calculator Project was featured in USDA Blog on Feb 17, 2016: http://blogs.usda.gov/2016/02/17/innovation-in-the-tropics-helps-farmers-conserve-resources-and-improve-soil-health/

Looking Ahead….

There are continued barriers to convince all farmers to calculate Plant Available Nitrogen mineralized from cover crops, especially for farmers that do not have good mathematic background. We have introduced this concept of using Cover Crop Calculator for PAN mineralization estimation to current CTAHR Cooperative Extension Agents. Creating an easy to use conversion table based on farming location and cover crop use might make the adoption process goes smoother. We already generated significant amount of data to support soil health management can improve plant health. For example:



Corn yield is highly corresponding to soil organic matter, field capacity, soil porosity, infiltration rates as shown in diagram above. Currently PIs of this project are working with NRCS to further evaluate how these soil health indicators also lead to soil-borne disease suppression.