Use of Cover Crops and Biofumigation
for Plant-parasitic Nematode Control in Pineapple
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We had three objectives: 1) to demonstrate to the Pineapple Growers Association of Hawaii (PGAH) the efficacy of cover crops in reducing preplant nematode population densities; 2) to illustrate that yield associated with biofumigation is comparable to yield associated with fumigation with 1,3-dichloropropene; and 3) to stimulate and encourage establishment of additional, independent field-scale cover crop and biofumigation evaluations.

Project Assessment

Brassica species produce large amounts of glucosinolates which convert to a variety of potential allelochemicals when tissue is mechanically damaged. *Brassica napus* var. *napus* 'Dwarf Essex' produces large quantities of glucosinolates and thus a good choice as a green manure with potential to reduce nematodes and weed pressure.

Demonstration 1. A Dole Fresh Fruit Co. field was sampled for nematode population densities and planted to rape seed, *B. napus* 'Dwarf Essex', at 0, 7, 14, and 20 kg/ha. Plant biomass of weeds and rape seed were recorded after 180 days. A portion of the untreated (no cover crop) and the 20 kg/ha seeding rate were tilled for biofumigation. Soil samples were collected from these plots. One half of the tilled area was covered with plastic mulch and the remaining half left bare. Soil was sampled 2 weeks later to assay for nematodes and 5-week-old tomato (*Lycopersicon esculentum* cv. Rutgers) seedlings were planted as indicators of nematode damage. Tomato plants were harvested 35 days after planting, above-ground biomass weighed, and the roots rated for galling by (*Meloidogyne javanica*). Roots were shaken in a 10% solution of sodium hypochlorite for 5 min to extract nematode eggs.

Rootknot and reniform nematodes did not reproduce on the rapeseed (Table 1). The nematode population densities were low at beginning to the experiment and continued to be low at the end of the experiment. The biofumigation showed more nematodes in the amended-solarized treatments than the unamended treatments, probably reflecting better tomato growth in the amended treatments allowing greater numbers of rootknot reproduction (Table 2). The rapeseed demonstrate promise as an alternative weed control strategy.

Table. 1. Mean number of nematodes in different treatments 0, 105, and 170 days after planting rapeseed.

Treatment	Nematodes/250 cm^3 soil					
	Reinform			Rootknot		
	0	105	170	0	105	170

No rapeseed—No solarization	50	40	30	10	30	0
No rapeseed—Solarization	30	20	20	40	40	0
Rapeseed—No solarization	0	30	210	110	90	0
Rapeseed—Solarization	60	0	70	140	10	0

Table 2. Mean number of rootknot nematode eggs and tomato bioassay root weight of biofumigated soil.

Treatment	Roots (g)		Rootknot eggs	
No rapeseed—No solarization	117	a	3.26	a
No rapeseed—Solarization	113	a	3.08	a
Rapeseed—No solarization	91	a	4.07	b
Rapeseed—Solarization	101	a	4.08	b

Demonstration 2. Dwarf Essex was planted in a Del Monte field at 16 kg/ha. Dry matter accumulation of weeds and rape seed was recorded 180 days after planting. Soil samples were to compare nematode population densities.

Dry weight accumulation of Dwarf Essex was 6,000kg/ha. The rapeseed stand was very uneven and early emerging plants began to senesce 104 days after planting. Grassy weeds (*Digitaria sanquinalis*, *Elusine indica*, and *Triachne insularis*) predominated where the rapeseed had senescenced early. Areas where the Dwarf Essex continued to grow remained devoid of any weeds. Nematode populations did not increase in the Dwarf Essex planting (Table 3). Microbiverous nematodes were more abundant in the rapeseed plots than in fallow areas. High populations of microbiverous nematodes indicate an increase biodiversity and thus an increase in microorganisms that can prey on plant-parasitic nematodes. Dwarf Essex could be useful in suppressing weeds if maintained in a healthy and vigorous state.

Table 3. Nematode populations 104 days after planting Dwarf Essex or soil left as a dry weed-free fallow.

Soil Sample Description	**Nematodes/250 cm^3**		
	Reniform	**Spiral**	**Pin**
Block #69, DE roots	1280	890	10
Block#68, DE roots	890	1070	110
Block #65, DE roots	660	260	10
Block #64, DE roots	330	0	0
Block #67, Dry Fallow	740	30	50
Block #66, Dry Fallow	550	60	70

Demonstration 3. Two cultivars of *Brassica napus* Aspen and Dwarf Essex with low and high glucosinolate levels, respectively, were grown for 10 weeks and harvested. The biomass was incorporated in to *M. javanica* infested soil at 50 g tissue/500 g soil. The soil was placed in a plastic bag. A nonamended bag of soil was also made. One set of bags were solarized by placing them in the sun in the greenhouse for 16 days. After solarization, the soil was bioassayed a tomato. Thirty days after planting, the tomato plants were removed from the pots, the roots shaken in sodium hypochlorite to release eggs, and the shoots weighed.

Fewer rootknot nematode eggs were recovered on the tomatoes grown in solarized soil than in the nonsolarized soil (Fig. 1). Fewer rootknot eggs were found on the soil amended with Dwarf Essex than with Aspen (Fig. 1). The tomato plants grown in the rapeseed amended soil were larger than those grown in the unamended soil (Fig. 2).

Demonstration 4. A ground cover of sunn hemp (*Crotalaria juncea*) was planted in the organic production block at Maui Pineapple. Sunn hemp was planted either in rows or broadcast and incorporated with light disking. Weeds were allowed to grow in an area adjacent to the sunn hemp planting and represented the current intercrop practice referred to as a weedy fallow (WF). The sunn hemp was harvested for seed and the residues were incorporated. Pineapple was planted and weed counts were recorded.

Dry weight accumulation of weeds was reduced by 67% in broadcast seeded sunn hemp and 24% where sunn hemp was seeded in rows. These observations indicated that incorporated sunn hemp residues might be able to inhibit weed growth.

Conclusions

These demonstrations have sparked interest and created first-hand credibility with cooperators. The pineapple IPM certification program has sparked interest in cover crops and our demonstrations (with much modification) have helped to assist in their adoption. Weed pressure was greatly reduced by the rapeseed and sunn hemp cover crops in the field. Effects on plant-parasitic nematodes were less apparent in the field demonstrations. However, in greenhouse tests, Dwarf Essex reduced rootknot nematode populations as compared to an unamended control. Allelopathic effects may be responsible for reduced weed growth. It appears that sunn hemp and Dwarf Essex are promising cover crops for weed suppression during the pineapple inter crop cycle.