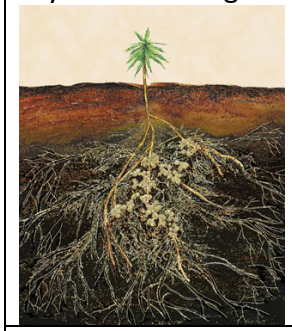
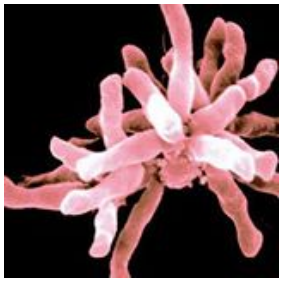
The frequent use of synthetic fertilizers and pesticides has lead to disruption of soil health, which often goes unnoticed. New generations of farmers are seeking profitable organic food crop production. Prohibitively high costs of organic fertilizers in Hawaii are providing incentive for farmers to utilize beneficial microorganisms to improve plant health. Many organic farmers are well aware of the benefits of beneficial soil microorganisms for farming. This handout introduces several approaches to invigorate soil microbial activities in agroecosystems to manage root health for profitable fertility and some soil-born stress or disease management.

Inoculum	Function
Mycorrhizal fungi 	Mycorrhizal fungi possess a mutualistic relationship between a fungus and the roots of a vascular plant. Mycorrhizal fungi associations with plants roots resulted in extension of plants roots, acting as an additional root system. Benefits include: • Enhancing seedling growth, rooting of cuttings, and establishment of transplants, • Increasing plant nutrient uptake, thus reduce fertility requirement of plants, • Increasing plant drought and stress (e.g. salt) tolerance, • Inducing host plant resistance or protection to pathogens and pests, • Producing more stress resistant landscape plants, and • Remediating soil pollutants such as petroleum or heavy metal. Special attention should be paid to compatibility of the host plant and its mycorrhizal fungus.
Azospirillum brasilense 	*Azospirillum brasilense*, a well-studied plant growth promoting and nitrogen-fixing bacteria, possesses a mutualistic relationship closely with grasses and cereals. Its vibroid shaped cell has a single polar flagellum, making it mobile in water allowing it to attach to plant roots. The bacteria utilize ribose and mannose from the plant, but in return it: • secretes plant growth hormone such as Indole Acetic Acid (IAA) that promotes shoot growth, and cytokinin-like substances that promote root hair formation, • stimulates root growth in favor of better mineral and water uptake, • fixes nitrogen through assimilation of ammonium and the activity of nitrogenase. Nitrogen fixation occurs under microaerobic conditions where nitrogen is limited. Although *Azosprillum brasilense* is routinely found in agricultural lands, seed/seedling treatments provide a head start and increase stress tolerance.
Vermicompost tea 	Vermicompost is a non-thermophilic biodegradation of organic material by combined action of earthworms and their associated microbes. The compost is a highly fertile, finely formed peat like material with high porosity, aeration, water holding capacity, and low in C: N ratios. Vermicompost has been shown to increase plant available nutrients, plant growth promoting organic acids, and promote high microbial activities in the soil that eventually leads to plant tolerance to stress. Drenching of vermicompost tea to seedlings increased seedling vigor, N content, carotenoids, and glucosinolates in tissue of pak choi; suppress various insect and nematode pests and soil-borne pathogens. This is due to an abundance of plant growth promoting rhizobacteria (PGPR) from the vermicompost, which colonized the plant roots and resulted in induced systemic resistance on the drenched plants. Vermicompost tea can be prepared by diluting freshly harvested vermicompost at 10-20% (w/w) in water and brew overnight using an air pump.

IMO4 	Indigenous microorganisms (Korean Natural Farming) Indigenous microorganisms compost (IMO4) is a form of mesophilic compost prepared by culturing soil microorganisms collected from natural areas close to the farm to be treated, favorably from bamboo leaf liters, deliberately cultured using farm waste through Korean Natural Farming practice. When reintroducing these indigenous microorganisms along with some foliar sprays prepared from nutrient extracts of farm or kitchen waste (without additional fertilizer inputs) into an agroecosystem in a no-till and organic mulching system, soil tilt and soil food web structure were improved. Crop yield was equivalent to an organic farming practice using organic fertilizer. Introduction of IMO4 could serve as a faster approach to restore soil health in a disturbed agroecosystem.
 **Oyster mushroom**	Saprophytic fungi (spent oyster mushroom compost) Several edible mushrooms are known for their nematode antagonistic capabilities. These include oyster mushrooms (*Pleurotus ostreatus*), shaggy mushroom *Coprinus comatus)*, Shiitake (*Lentinula edodes*), *Nematoctonus concurrens*, and King Stropharia (*Stropharia rugosoannulata*). These fungi use different mechanisms to kill nematodes, mostly by exuding a toxin to paralyze the nematodes, so they can penetrate and consume them. Applying spent mushroom compost as a surface mulch under the canopy of tree seedlings, or mix into potting mix at 2% amendment rate for transplant seedlings is being investigated for their potential against infection of plant-parasitic nematodes.
Chitinolytic microbes 	Shrimp shell meal A slow-release organic fertilizer (5% N, 8% P, 15% Ca, 18% chitin and trace minerals), derived from ground-up shrimp shells. When amended to soil at 35 lb/1000 ft^2, it enhances chitin-feeding microbes in the soil. Since nematode eggshells are made of chitin, shrimp shell meal or its equivalent like crab shell meal is well known for its nematicidal properties. Unfortunately this soil amendment is not available locally.

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