EVALUATING THE QUALITY OF LOCALLY PRODUCED LIQUID ORGANIC FERTILIZER FOR SEEDLINGS QUALITY AND CROP YIELD

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INTRODUCTION:

Fertigation (Fertilizer + Irrigation) is the injection of fertilizers through the irrigation system. Fertigation can be a successful and profitable method to apply plant available nutrient to crops, especially under organic farming systems. This is largely due to the time needed to convert nutrients from their organic form into inorganic forms, which the plant can then uptake. The need for affordable soluble fertilizers derived from locally available resources is crucial for environmental protection, resource conservation, growers' profitability and long-term sustainability. Fertigation is suitable for field condition, green-/screen-house, and hydroponic system (on a small or large scale).

Applying fertilizers through the irrigation system:

- Allows flexibility in timing fertilizer application.
- Allows fertilizer distribution to be as uniform as the water application.
- Reduces the labor required for applying fertilizer, compared to other methods.
- Allows less fertilizer to be applied compared to other fertilization methods.
- Applicable for long-term crops and mulching practices.
- Leads to lower production costs and higher profitability.

Hawai'i vegetable farmers typically do not direct seed. The common practices is to produce vegetable seedlings in celled trays for later transplant into the field. Transplanting strong seedlings can improve crop establishment and yield by reducing early plant loss due to pests, birds, and diseases. Transplanted crops are typically more uniform than direct seeded plantings. The growth of seedlings can be controlled through fertility and water management. As a result, they can be held longer and transplanted as needed. Other potential benefits of producing strong seedlings include: earlier crop harvest, rapid crop turnover, and reduced cost for weed, and pest management.

Two aspects affect seedling quality: 1) genetic quality of the parental seed line and 2) physical condition of seedling at transplant. Improving on the genetic quality of seedlings requires a long-term strategy of seed selection and plant breeding, while improving the physical quality of seedlings can be done through advancement of media quality and crop nutrition.

Two studies (greenhouse and field) were conducted to evaluate the quality and productivity of using liquid organic fertilizer, in comparison to liquid synthetic fertilizer. Water was used as a control. The focus of the study was on seedlings quality (green-house) and total crop yield (field).

MATERIALS &METHODS:

Tankage is the solid byproduct of animal waste rendering (Fig. 1). The nutrient content of tankage will vary with feedstock and storage time, but the product in Hawai'i has been fairly consistently analyzed at 9.5, 2.5, 0.75, and 5.0% N, P, K, and calcium (Ca), respectively with a C:N of 5:1.

Liquid organic fertilizer using tankage and vermicompost was developed by mixing 1.5 lbs. of tankage, an ounce (1 oz) of vermicompost, and 10 gallons of water. The solution was extracted for 12 to 24 hours (the liquid organic fertilizer was used for seedling and field trials) using an air pump. The aqueous solution was strained and then applied to the seedlings and injected into the drip lines in the field trials.

Figure 1: Tankage

Vermicompost is used in the recipe with a very small amount. The vermicompost is not a source of nutrient, but a source of biology to enhance the release of the nutrient from tankage. Its suggested to use a fresh vermicompost, as much as possible.

This liquid organic fertilizer recipe, with a high nitrate (NO_3-N) content, was developed locally in Hawaii through a Western Sustainable Agriculture Research & Education (SARE) funded project (SW14-026) and Hawaii Department of Agriculture (Contract # 64569) using the locally produced organic fertilizer (Tankage).

The liquid organic fertilizer solution was applied to the seedlings of four crops (chili peppers, tomato, kai choy, and papaya) in greenhouse studies. It was also applied to three crops in a field setting (lettuce, pak choi, and daikon). Seeds were planted in 50 cell trays (for both greenhouse and field trials) filled with Sunshine® potting mix. Each crop was planted in 3 trays (replicates) in a complete randomized design (CRD)

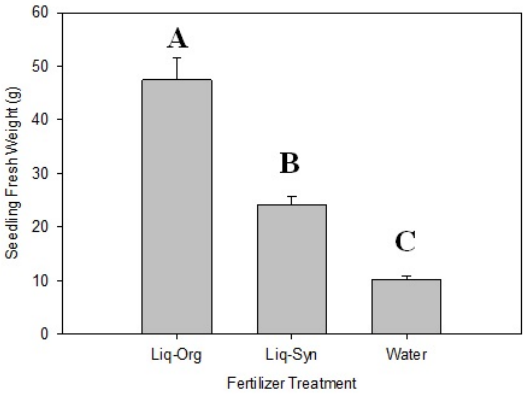
The liquid organic fertilizer was compared to liquid synthetic fertilizer (made from miracle grow fertilizer) and water, used as a control. Fertigation treatments were applied weekly (for greenhouse and field trials), beginning one week after seed germination(greenhouse) and immediately after transplant (field).In the field trials, lettuce and pak choi were harvested four weeks after transplant and daikon was harvested 6 weeks after transplant.

RESULTS & DISCUSSION:

The liquid organic fertilizer showed significant differences for all measured parameters, compared to the liquid synthetic fertilizer and water control. The liquid synthetic fertilizer showed significant results compared to the water control. Percent increase in fresh and dry weight, for the four crops, between liquid organic/liquid synthetic, liquid organic/water only, and liquid synthetic/water treatments varied between 12-49%, 40-79%, and 27-58%, respectively.

Implications of this greenhouse study suggest improving the quality of seedlings can lead to uniform field growth, early harvest crops, higher yields, and may allow for an increase in harvest per year.

Figure 2: Bell pepper seedling growth response to the application of liquid organic, liquid synthetic, and water only application under peat moss media, respectively.



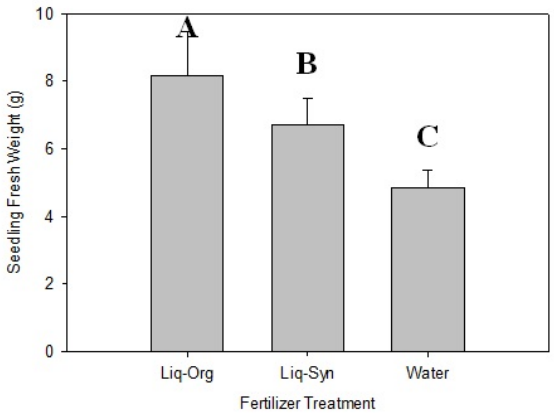


Figure 3:A) Papaya and B) Tomato seedling growth response to the application of liquid organic, liquid synthetic, and water only application under Sunshine® potting media, respectively.

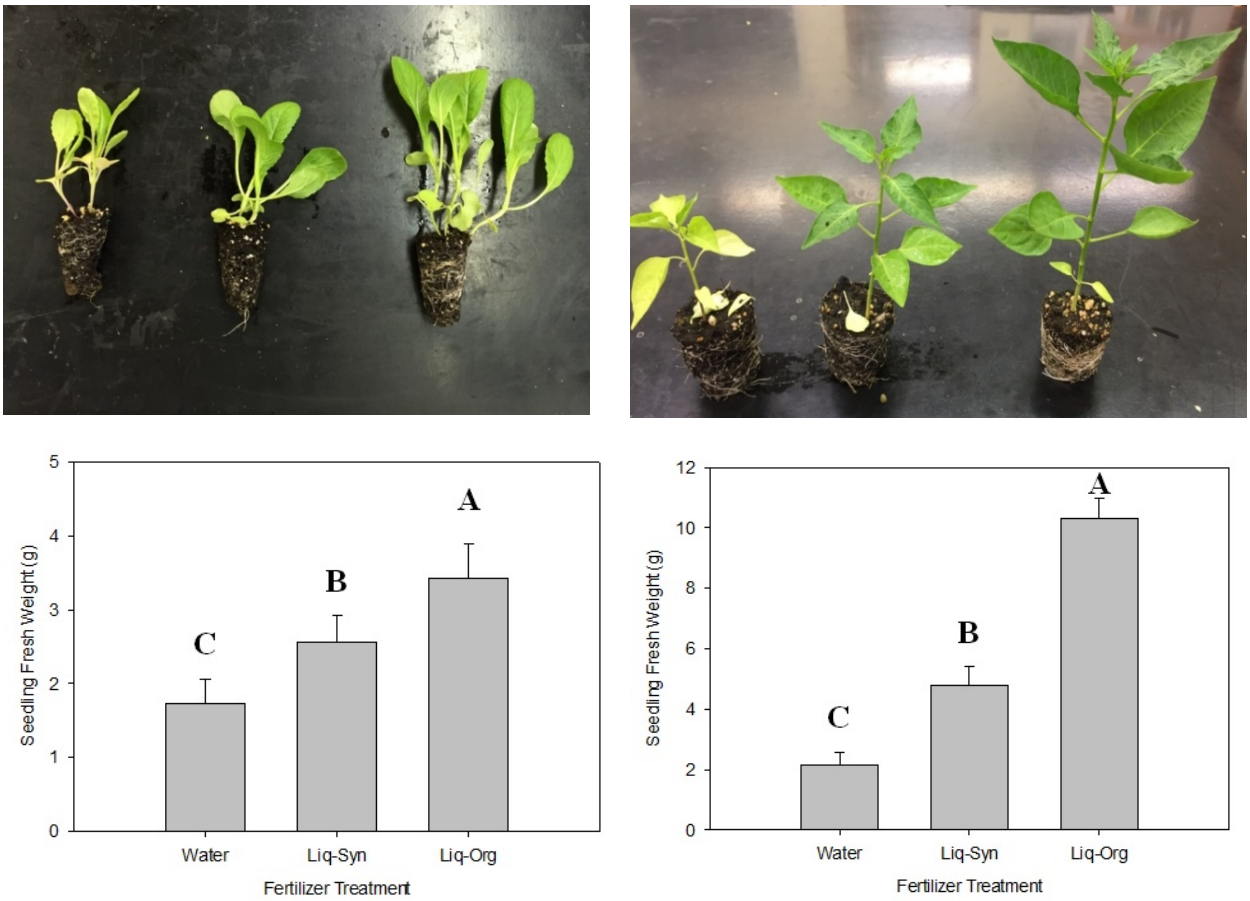


Figure 4: A) Kai Choy and B) Chili Pepper seedling growth response to the application of water, liquid synthetic, and liquid organic application under Sunshine® potting media, respectively.

Figure 5:A) Liquid fertilizer injection kit and B) Daikon yield under liquid synthetic (left) and liquid organic (right).

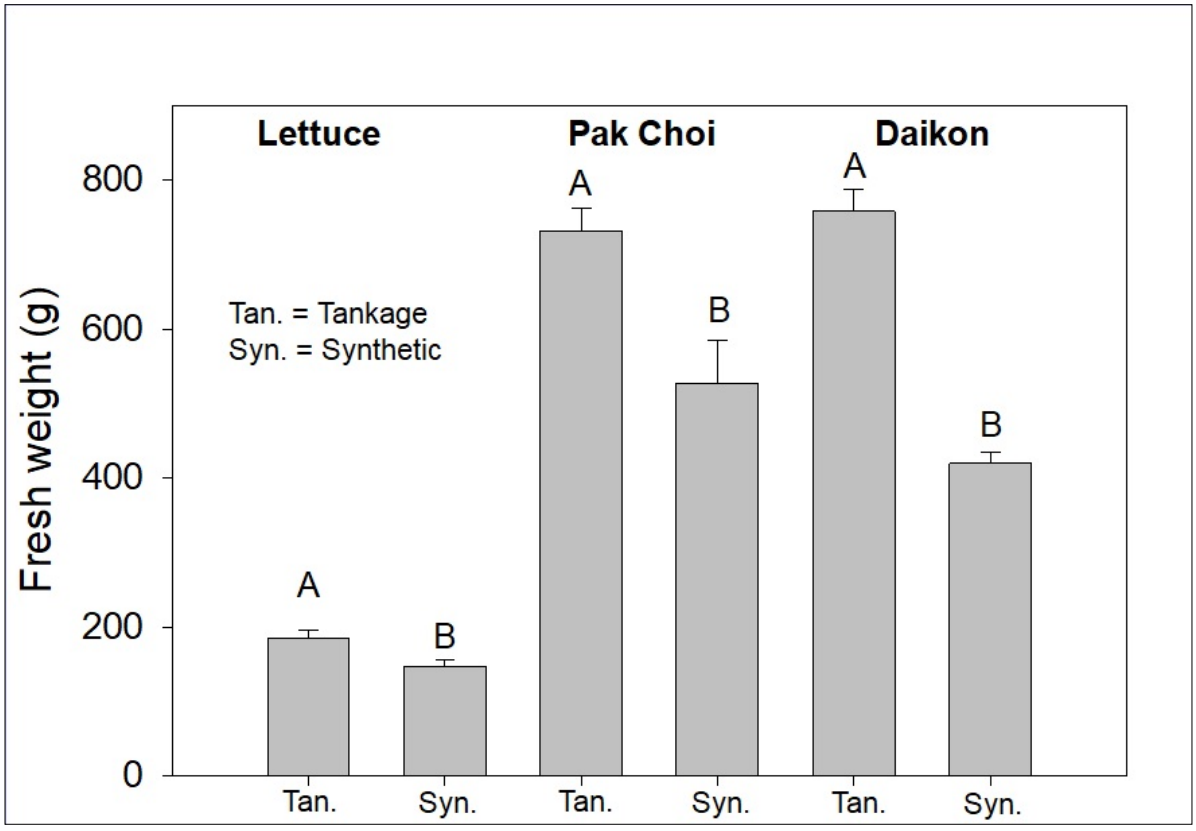


Figure 6: Yield comparison between liquid organic fertilizer (Tan) and liquid synthetic (Syn) for lettuce, pak choi, and daikon crops.

Both liquid organic and synthetic fertilizers were applied at the same total (~ 50 ppm) nitrate (NO_3-N) content. Plants treated with liquid organic fertilizer showed a significant plant response. The significant response by seedling and crops grown with liquid organic fertilizer might be attributed to the fact that the liquid organic fertilizer contained all macro- and micro-nutrient compared to synthetic liquid fertilizer, based on a chemical analysis.

Adoption of liquid organic fertilizer can replace the dependency on liquid synthetic fertilizers. Liquid organic fertilizers are made from locally available resources and can be applicable to small to large producers. Utilization of fertigation injection systems can help producers apply liquid organic fertilizers uniformly over large areas, reduce labor in applying granular fertilizers, reduce dependency on imported fertilizers, lower production cost, and maintain or enhance crop production yields.

RESOURCES:

How to prepare the liquid organic fertilizer using tankage and vermicompost:

- Mix 1.5 lbs of tankage with an ounce (1 oz) of vermicompost.
- Add the mix into a bucket with 10-gallons water.
- Using air pump, brew/extract the mix for 12 to 24 hours
- Strain the aqueous solution and fertigate (fertilizer + irrigation) the seedlings.

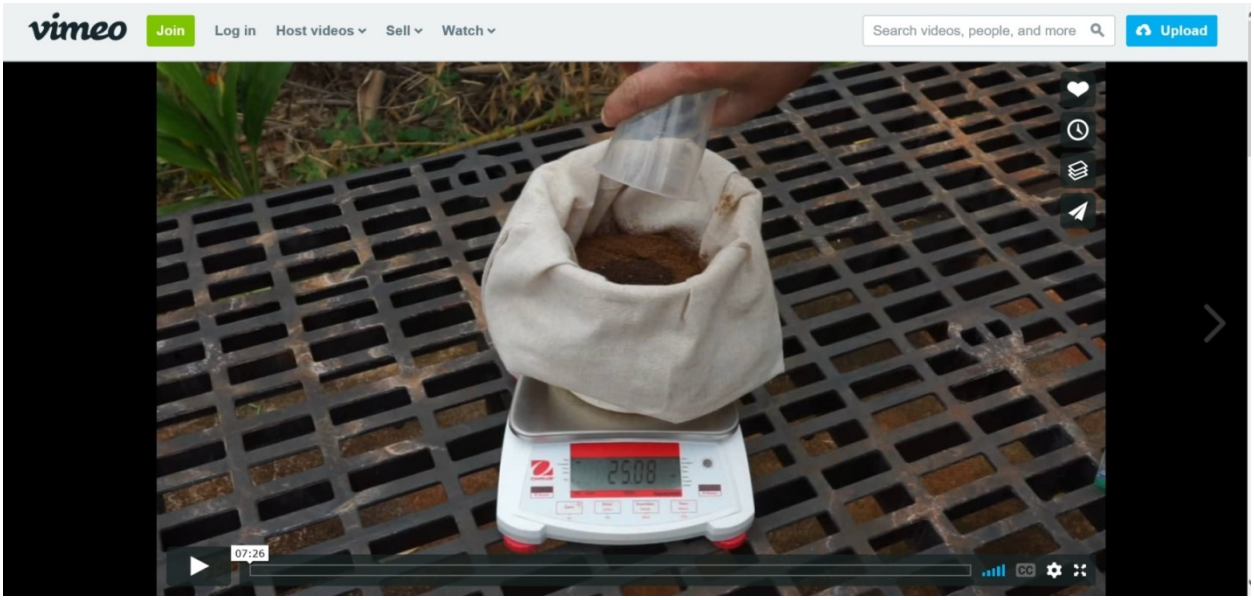


Figure (1): Video demonstration for the recipe of liquid organic fertilizer preparation.
Video can be found here: https://vimeo.com/245473495

Please note:

- The liquid organic fertilizer is meant to be as a supplemental application of nutrient and not main source.

- For crop with high demand for nutrient, apply 50% of the nutrient up front and supply the liquid organic fertilizer weekly or biweekly throughout the growing season.
- Do not spray the liquid organic fertilizer as a foliar, since it has high nitrogen content and that may lead to burn plant foliar.

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