# Evaluating Biosolarization as an IPM Tactic in Vegetable Production.


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AgFS Agriculture & Food Systems


## Introduction

- Integrated weed management (IWM) is essential in vegetable production due to limited herbicide options. Furthermore, many herbicides lack full-season weed control and pose a risk of crop injury. In organic farming, growers dedicate considerable time and labor to manual and mechanical weed control due to substantial weed challenges.
- Biosolarization presents a promising option for IWM. Research indicates that it can enhance weed seed mortality, reduce soil pathogens, and is compatible with organic farming.
- Biosolarization is similar to solarization but incorporates organic amendments into the soil before the passive solar heating process. As the moist soil undergoes heating, the organic material decomposes, releasing allelochemicals and other biotoxic compounds into the soil. Following about 14 days of biosolarization, the plastic mulch is removed, enabling the soil to aerate for seven days before crop transplant.
- Fruit processing by-products (pomace) are promising biosolarization soil amendments because they are rich in organic compounds, don't pose any biohazard risks, and are relatively abundant and inexpensive.

## Objectives

- Develop a novel practice that vegetable farmers can utilize to manage multiple crop pests.
- Evaluate how a fruit-based biosolarization, living mulch and strip tillage system solo and combined can manipulate insects and weeds.

## Methods

- Study performed at Central Maryland Research & Education Center, Upper Marlboro, MD and consisted of a RCBD with 4 treatments and 4 replications.
- Treatments comprised of eggplant:
  1. Grown in living mulch + no-till (LM-NT)
  2. Interplanted with cover crops (LM)
  3. Grown in solarized soil (Sol)
  4. Interplanted with cover crops & grown in biosolarized soil (Biosol)
- In the Fall – a red clover + cereal rye mix was planted on 6-inch rows in LM, Biosol & Sol plots. In LM-NT plots, red clover and cereal rye were seeded in alternating rows (6 rows rye & 4 rows red clover)
- In the Spring – LM-NT: entire plot roller-crimped. LM: entire plot roller-crimped, and crop row strip-rotovated (40" wide). Sol: entire plot mowed and rotovated then transparent plastic & drip lines laid in the row. Biosol: entire plot mowed, strip rotovated within crop row, pomace incorporated into stripped row, transparent plastic and drip line laid, biosolarization proceeds and plastic removed after 14 days, soil aerated for 7 days, crop transplanted.

*Data Collection*

- Weed assessments: species & counts @ 2, 4, 6 & 9 weeks after planting (WAP)
- Crop growth: height, width & yield

*Statistical Analysis*

- Data subjected to ANOVA using JMP Pro 16. Treatment means were separated using Student's t-test (α = 0.05).

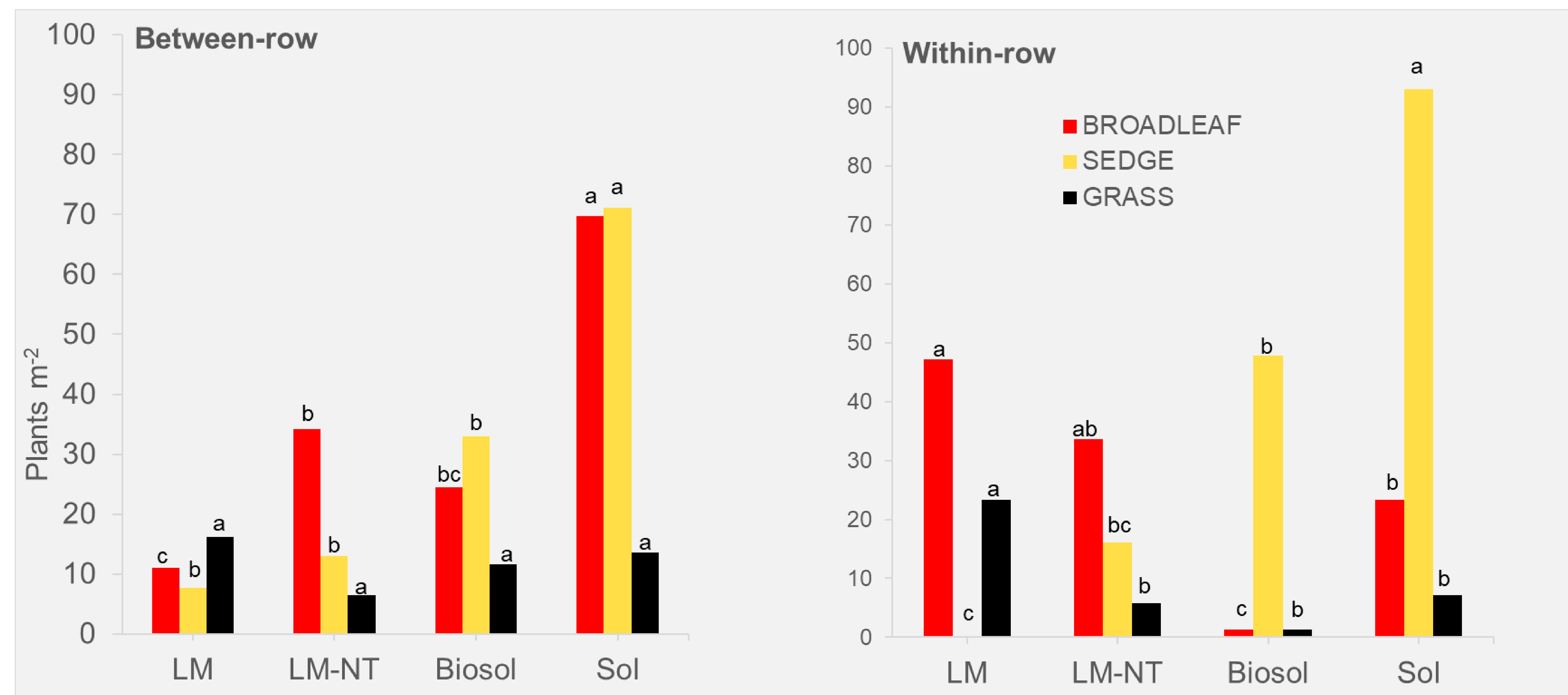


**Figure 1.** Early-season (2 WAP) between & within-row weed abundance & type in response to treatments

Values with the same letter in the same area & weed type are not significantly different according to the Student's t-test (α=0.05)

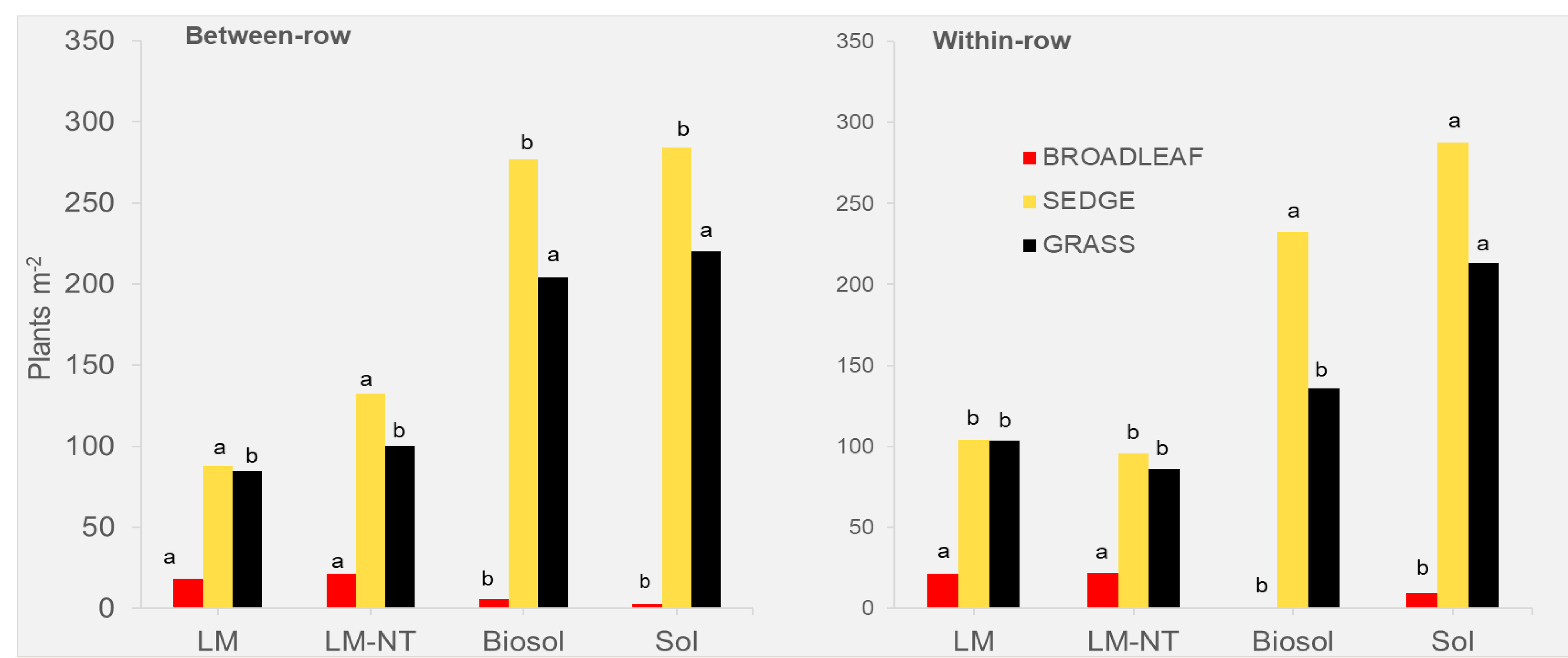


**Figure 2.** Late-season (9 WAP) between & within-row weed abundance & type in response to treatments

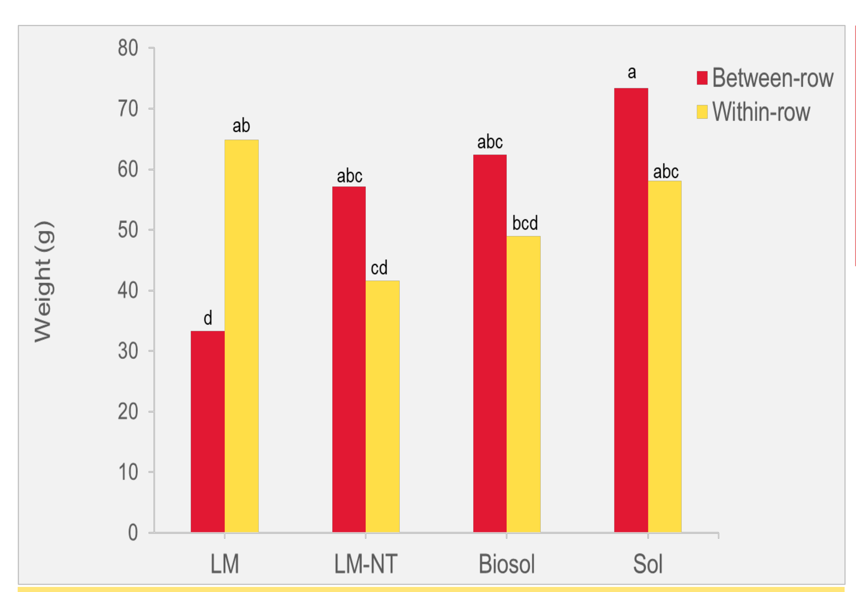


**Figure 3.** Between & within-row weed biomass in response to treatment at 9 WAP.

Values with the same letter are not significantly different according to the Student's t-test (α=0.05)

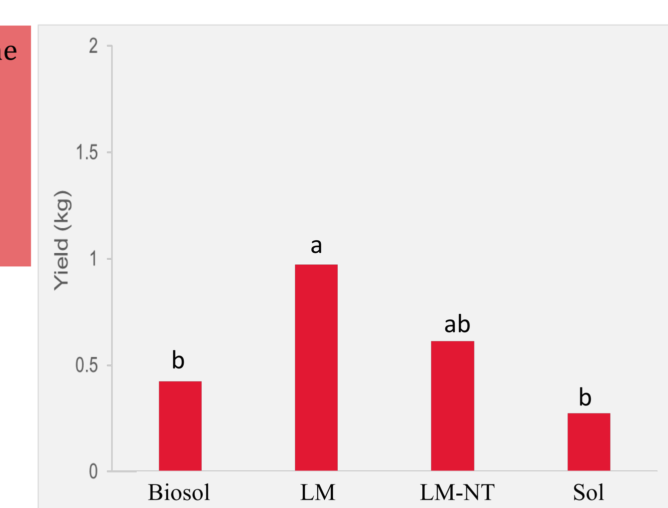


**Figure 4.** Mean eggplant yield in response to treatment


**Picture 1. A)** Dried grape pomace, and **B)** dried apple pomace before being applied to the soil, and **C)** before soil incorporation in Biosol plot.

**Picture 2.** Biosol treatment with transparent mulch & drip line as it undergoes passive solar heating

## Results

- Biosol plots had the lowest number of within-row broadleaf weeds (Figs. 1 & 2).
- Overall, within-row broadleaf weeds were greatest in LM plots (Figs. 1 & 2).
- Overall, sedge weeds were greater in Biosol and Sol plots compared to LM and LM-NT plots (Figs. 1 & 2).
- LM plots had the most early-season grass weeds (Fig. 1).
- Sol plots had the most late-season grass weeds (Fig. 2).
- All treatments, except LM, had greater weed biomass in the between-row areas compared to within-row (Fig 3).
- Greatest mean yield was observed in LM followed by LM-NT, Biosol then Sol plots (Fig. 4).

## Discussion

- The results tentatively show that broadleaf weed seeds were effectively inactivated by biosolarization.
- Biosolarization did not effectively control nutsedge. Yellow nutsedge, a perennial primarily reproducing through tubers, showed no adverse response to solarization or biosolarization, likely due to its vegetative propagation ability. Additionally, increased tillage in Biosol and Sol plots may have affected nutsedge density. Effective suppression of nutsedge was observed in conservation tillage plots (LM & LM-NT), attributed to minimal soil disturbance, particularly in the no-till treatment. Furthermore, the presence of cereal rye residue not only kept the soil surface cool but also hindered the light stimuli necessary for nutsedge tuber buds to emerge.
- Seeded annual grasses were the primary grassy weeds found in plots. Biosolarization effectively inactivated their seeds, providing early-season control. However, its effectiveness significantly diminished by late-season.
- The results suggest biosolarization may be a viable option for weed management within the crop row. Moreover, it may prove to be an effective IWM tactic in organic vegetable production. However, additional research is needed to confirm these results.

## Future Work

- Assess various pomace types as soil amendments for biosolarization.
- Conduct greenhouse experiments to assess the efficacy of biosolarization on yellow nutsedge and other vegetatively propagating weeds.


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