# Alternative Germination Mixes for Starting Transplants

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**Abstract.** A trial was conducted at ECHO Global Farm in North Fort Myers, Florida to make and evaluate potting mixes that could serve as effective substitutes for purchased potting mediums, since ready-made potting mixes are typically unavailable, impractical or expensive in many developing countries. Twelve potting mixes in total were evaluated, each with it's own unique ratio of materials. Materials used include compost, manure, sand, rice hulls, and charred rice hulls. All mixtures were compared to a comercial potting mixed Fafard™ 2 Mix. Of the alternative potting mixes, recipe 9 (1:1:1 Manure, Compost, Charred Rice Hulls) produced the most seedling biomass. Recipe 9, as well as recipes 10 (2:2:1 Manure, Compost, Sand) and 12 (1:1 Manure, Compost), all resulted in healthy seedlings with similar total weights as with pure Fafard 2 Mix.

## Introduction and Purpose

ECHO staff are sometimes asked what we recommend for a germination medium in situations where seeds or seedlings need to be started in pots or plastic sacks before going out to the field. This past summer, we conducted a trial at ECHO to make and evaluate potting mixes that could serve as effective substitutes for purchased potting mediums, since ready-made potting mixes are typically unavailable, impractical or expensive in many developing countries. Nurseries usually resort to developing some ratio of topsoil, sand, and organic material (e.g. animal manure and/or compost) to serve as a potting medium. For our trial, we sought to use ingredients that would be accessible in many areas of the developing world. Based on some common potting mix recipes, we developed a series of recipes using the following components: sand, cow manure, compost, and both charred and un-charred rice hulls.

The trial was conducted in the ECHO greenhouse, where seedlings could be monitored and watered regularly. Using maize (*Zea mays*) as an indicator crop, our goal was to identify one or more potting mediums that would prove suitable for a healthy, uniform population of seedlings for use as transplants.

## Materials and Methods

We chose the following twelve potting mix recipes with which to conduct our experiment in Summer 2009:

1. 100% Fafard™ 2 Mix (Control 1; www.fafard.com)
2. ECHO-modified Fafard™ 2 Mix (Control 2; contained soluble fertilizer, dolomite (lime containing calcium and magnesium), and mycorrhizae)
3. 4:1 Manure, Sand
4. 2:1 Manure, Rice Hulls
5. 2:1 Manure, Charred Rice Hulls (burned slowly in a pile with little or no flame)
6. 4:1 Compost, Sand

7. 2:1 Compost, Rice Hulls
8. 2:1 Compost, Charred Rice Hulls
9. 1:1:1 Manure, Compost, Charred Rice Hulls
10. 2:2:1 Manure, Compost, Sand
11. 1:1:1 Manure, Compost, Rice Hulls
12. 1:1 Manure, Compost

Each recipe was replicated four times. For each replication, 25 maize seeds were planted individually in cells of a planting tray, one inch (2.5 cm) deep. Trays were arranged in the greenhouse using a randomized block design, and were uniformly watered on a daily basis. Except for the ECHO-modified Fafard™ 2 Mix, no additional fertilizer was added to any mixtures.

Two weeks after seeding, we counted the number of plants in the center nine cells of each maize replication, rated leaf color, and measured plant height (germination, color and height data are shown in Table 1).

**Table 1.** Effect of potting mix on maize seedling height, leaf color, biomass and plant number with nine planted seeds.

| Potting Mix | Height (cm) | Color* (1-5) | Total Mass (g) | Root Mass (g) | Shoot Mass (g) | Plants germinated (no.) |
|---|---|---|---|---|---|---|
| 1. 100% Fafard | 30 | 2.75 | 44.75 | 20.75 | 24 | 8 |
| 2. ECHO Fafard Potting Mix | 40.25 | 4.25 | 66.75 | 20.33 | 51.5 | 8.75 |
| 3. 4:1 Manure, Sand | 21.75 | 4 | 23 | 7.5 | 15.5 | 8.25 |
| 4. 2:1 Manure, Rice Hulls | 13.75 | 4.25 | 9.5 | 4.38 | 5.13 | 5 |
| 5. 2:1 Manure, Charred Rice Hulls | 24.5 | 4 | 25.75 | 8.75 | 17 | 8.33 |
| 6. 4:1 Compost, Sand | 13 | 1.5 | 15.5 | 10 | 5.5 | 8 |
| 7. 2:1 Compost, Rice Hulls | 11.75 | 1 | 17.75 | 11 | 9.5 | 8.25 |
| 8. 2:1 Compost, Charred Rice Hulls | 23.5 | 4.25 | 32.5 | 12.5 | 20 | 8.25 |
| 9. 1:1:1 Manure, Compost, Charred Rice Hulls | 30 | 4.25 | 49.25 | 17.25 | 32 | 9 |
| 10. 2:2:1 Manure, Compost, Sand | 27.25 | 4.25 | 38 | 13.25 | 24.75 | 8.75 |
| 11. 1:1:1 Manure, Compost, Rice Hulls | 23.5 | 3.75 | 28.75 | 12 | 16.75 | 8 |
| 12. 1:1 Manure, Compost | 29.75 | 3.75 | 41.75 | 15.25 | 26.5 | 8.5 |
| P value** | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | 0.008 |
| LSD value** | 7.01 | 0.69 | 12.75 | 5.01 | 9.06 | 1.67 |

*Color of shoots was rated on a scale of 1-5 with 1 being yellow and 5 being dark green.

**Significant differences between values within a column exist if the corresponding P value is equal to or less than 0.05 (5 % level of significance). Within a column, any two values are statistically different if the difference between them is greater than the corresponding least significant difference (LSD) value.

## Results and Discussion

Total biomass serves as an overall indicator of maize growth. The best maize growth, as indicated by total biomass, occurred with the ECHO-modified Fafard™ 2 Mix (Table 2). Interestingly, this mix resulted in better plant growth than the pure Fafard™ 2 Mix, indicating that the seedlings responded favorably to the amendments added by ECHO staff.

Of the alternative potting mixes, recipe 9 (1:1:1 Manure, Compost, Charred Rice Hulls) produced the most seedling biomass. Recipe 9, as well as recipes 10 (2:2:1 Manure, Compost, Sand) and 12 (1:1 Manure, Compost), all resulted in healthy seedlings with similar total weights as with pure Fafard™ 2 Mix. Each of these mixtures contained both manure and compost and resulted in more seedling growth than mixtures with just one or the other of these ingredients combined with sand or rice hulls.

Mixtures containing charred rice hulls did quite well. However, un-charred hulls seemed to allow the mixture to dry out rapidly, so that fewer seeds germinated (Table 1). Those that did germinate showed nutrient deficiencies, likely because the high carbon to nitrogen ratio of the un-charred rice hulls made nitrogen unavailable.

**Table 2.** Results of germination mix trial, showing total mass, root mass and shoot mass of maize plants grown in each type of mix. Top alternative performers are shown in boldface type below.

| | **Biomass (grams plant material in 9 planting cells)** | | |
|---|---|---|---|
| | **Total** | **Root** | **Shoot** |
| 100% Fafard 2 Mix | 44.8 | 20.8 | 24.0 |
| ECHO-modified Fafard 2 Mix | 66.8 | 20.3 | 51.5 |
| 4:1 Manure, Sand | 23.0 | 7.5 | 15.5 |
| 2:1 Manure, Rice Hulls | 9.5 | 4.4 | 5.1 |
| 2:1 Manure, Charred Rice Hulls | 25.8 | 8.8 | 17.0 |
| 4:1 Compost, Sand | 15.5 | 10.0 | 5.5 |
| 2:1 Compost, Rice Hulls | 17.8 | 11.0 | 9.5 |
| 2:1 Compost, Charred Rice Hulls | 32.5 | 12.5 | 20.0 |
| 1:1:1 Manure, Compost, Charred Rice Hulls | 49.3 | 17.3 | 32.0 |
| 2:2:1 Manure, Compost, Sand | 38.0 | 13.3 | 24.8 |
| 1:1:1 Manure, Compost, Rice Hulls | 28.8 | 12.0 | 16.8 |
| 1:1 Manure, Compost | 41.8 | 15.3 | 26.5 |
| P value* | <0.001 | <0.001 | <0.001 |
| LSD value* | 12.8 | 5.0 | 9.1 |

*Significant differences between values within a column exist if the corresponding P value is equal to or less than 0.05 (5 % level of significance). Within a column, any two values are statistically different if the difference between them is greater than the corresponding least significant difference (LSD) value.

## Conclusions and Recommendations

Considering that seedling growth was best with ECHO-modified Fafard™ 2 Mix amended with soluble fertilizer, dolomite (lime containing calcium and magnesium) and mycorrhizae, other mixtures would likely be improved by these amendments. This could be an area for further experimentation.

Combining materials (e.g. manure and compost) seems to increase the likelihood of obtaining a beneficial combination of nutrients/fertility and soil structure.

When using an amendment with a high carbon to nitrogen ratio, such as un-charred rice hulls, consider how well the resulting mixture retains moisture and what possible implications it will have on resulting nutrient availability to seedlings. High-carbon, woody materials can decrease fertility for a time as the microbes breaking them down tie up nutrients to sustain themselves at the expense of plant uptake.

This experiment was not exhaustive. For instance, we did not experiment with topsoil. Please let us know of your findings if you experiment with other recipes and ratios.

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