

# Optimal Growing Medium for Lettuce Seedlings Depends on Choice of Fertilizer

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## Introduction

Healthy vegetable seedlings are key to a good harvest. Larger transplants help to lower production costs by reducing the amount of time a crop needs to be in the field before harvest, and by giving the crop a head start on weeds. Numerous combinations of seedling media, fertilizer, and other amendments are available. Sunshine Mix, with regular or certified organic ingredients, is an industry standard. Coconut coir fiber is cheaper than the standard Sunshine Mix, and is approved for organic production. For fertilizer, Nutricote slow release fertilizer is a conventional option, while tankage, or fish/bone meal, is the main organic option. This study evaluated the effects of different combinations of media and fertilizer on the growth of romaine lettuce seedlings. The objective was to determine the effects of fertilizer type and choice of media on seedling growth.

## Methods

Two kinds of growing media (Sunshine Mix and coconut coir) were each paired with two types of fertilizer (Nutricote and tankage) for a total of four different treatments. Tankage was sifted through a size 10 mesh screen. Nutricote and tankage application rates were standardized based on total nitrogen content, assuming a total N content of 9% for the tankage (Table 1). The bulk density of each fertilizer amendment was measured and used to calculate fertilizer rates based on weight that were roughly equivalent to a 2.5% by volume mixture of Nutricote. Applications of fertilizer were weighed and mixed with media to create a total of 1000mL of mixture for each treatment. The mixture was placed in 18 cell trays, seeded with coated romaine lettuce seeds, covered with remaining mixture and watered.

	fert:media ratio by volume	media volume (mL)	fert. volume (mL)	fert. mass (g)	fert. % N
Nutricote	2.5%	975.0	25.0	26.1	13%
Tankage	5.5%	944.9	55.1	37.6	9%

Table 1. Fertilizer application rates and media volume (either Sunshine Mix or coconut coir) per treatment

Five replicates of each treatment were arranged in a randomized complete block design. Each replicate contained 18 plants. Seedlings were harvested 22 days after planting by cutting at the soil level. Ten randomly chosen subsamples within each replicate were weighed together to determine the mean fresh seedling weight. Dry weight was obtained by drying the subsamples at 70°C for 20 hours before weighing the ten subsamples from each replicate again. Dry weight data was analyzed using R (R Core Team 2014). Single degree of freedom contrasts were used to test for significant differences between treatment groups.

## Results

The effect of fertilizer type was different in each of the two media (Figure 1). Among plants receiving tankage as fertilizer, those grown in coconut coir had significantly higher weight than those grown in Sunshine Mix ( $F_{1,16}=8.13$ ,  $p=0.0116$ ). When Nutricote was used as the fertilizer, plants grown in Sunshine Mix performed significantly better than those in coconut coir ( $F_{1,16}=16.54$ ,  $p=0.0009$ ).

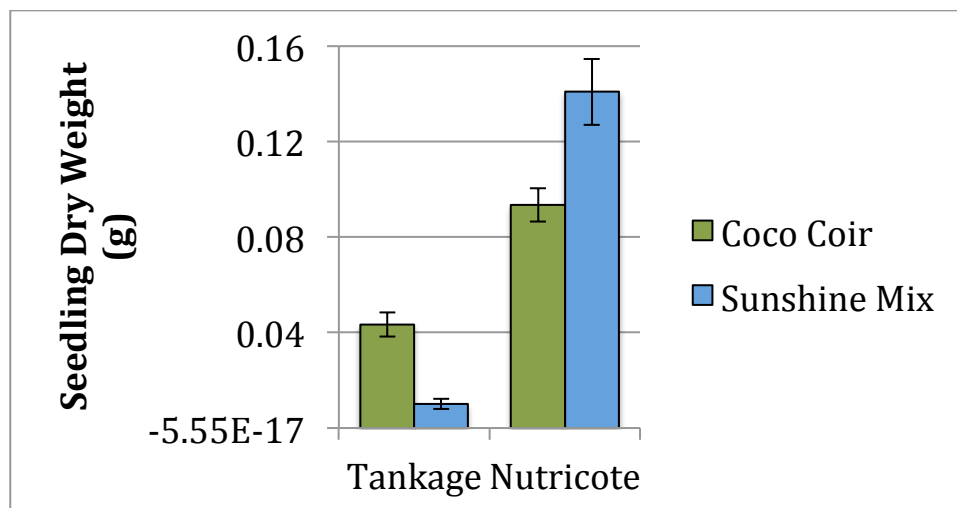


Figure 1: Effects of fertilizer and media on lettuce seedling dry weight. Standard error bars shown.

Nutricote was, however, the better fertilizer in either medium. In Sunshine Mix, seedlings fertilized with Nutricote had significantly higher weight than those fertilized with tankage ( $F_{1,16}=125.72$ ,  $p<0.0001$ ). In coconut coir as well, Nutricote-fertilized seedlings were significantly larger than tankage-fertilized seedlings ( $F_{1,16}=18.44$ ,  $p=0.0006$ ). Overall, Sunshine Mix plus Nutricote gave the best results, followed in descending order by coconut coir+Nutricote, coconut coir+tankage, and Sunshine Mix+tankage (Table 2, Figure 2).

Fertilizer	Media	Mean Dry Seedling Weight (g)	Standard Error
Nutricote	Sunshine Mix	0.141	0.014
Nutricote	Coco Coir	0.093	0.007
Tankage	Coco Coir	0.043	0.005
Tankage	Sunshine Mix	0.010	0.002

Table 2: Combinations of fertilizer and media in descending order of resulting lettuce seedling weight.

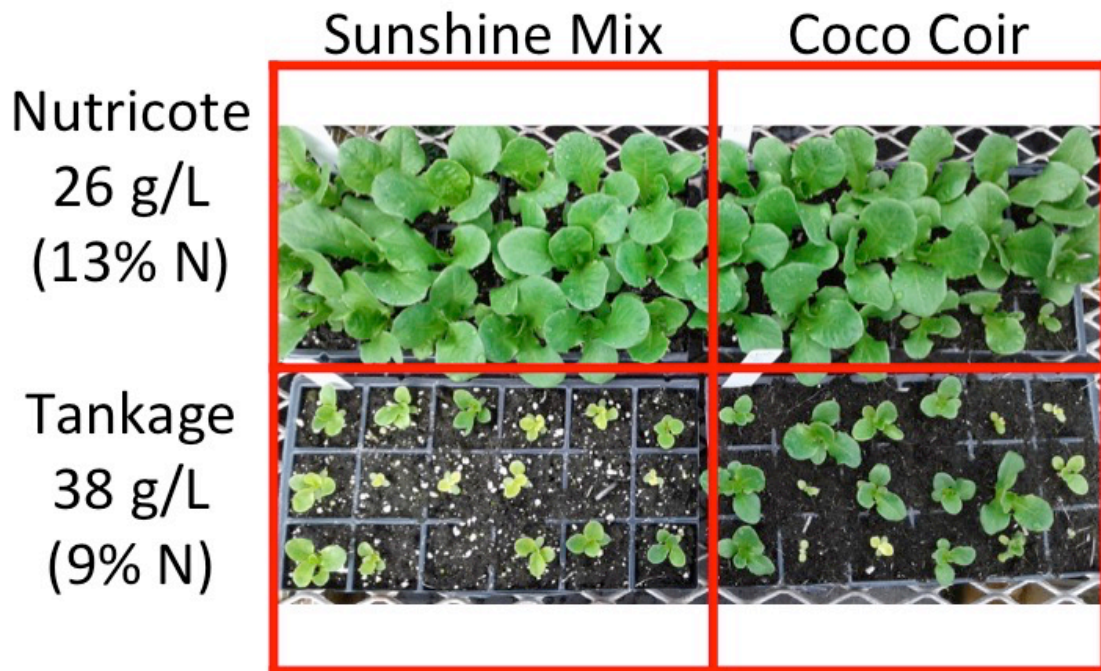


Figure 2. A representative set of treatments at 22 days after planting.

## **Discussion**

The interaction between media and fertilizer demonstrates that choosing an optimal seedling mix is not straightforward. Seedlings receiving tankage as fertilizer grew larger in coconut coir than in Sunshine Mix, whereas seedlings receiving Nutricote fared best in Sunshine Mix. Several factors may have influenced the interaction. The moisture-holding capacity of the medium, for example, may influence release rates of the fertilizers. Root burning from excess ammonium as tankage broke down, and leaching of nutrients out of the medium may have also played a role. It is difficult to determine the mechanism of the interaction from this experiment. Future studies should measure levels of plant-available nutrients in the seedling mixture at the time of harvest to determine whether excesses or deficiencies exist.

The generally poor performance of tankage as a fertilizer may have been due to slow release rate of nutrients. The sterile media may lack the microbial communities needed to decompose the organic forms of nitrogen and other nutrients in the tankage. Addition of small amounts of compost or soil or drenching with compost tea should be evaluated as means of inoculating the growing media with the necessary microbes. Pre-mixing tankage, media, and compost a week or more in advance of seeding may also lead to greater nutrient availability during the growth period. Pre-mixing may also allow time for potentially plant-toxic levels of ammonia ( $\text{NH}_4^+$ ) released from initial breakdown of tankage to be converted to nitrate ( $\text{NO}_3^-$ ).

Overall, this study showed that organic growers who are constrained to tankage as their only cost-effective choice of fertilizer should pair it with coconut coir rather than Sunshine Mix for better results. If given the choice of fertilizer, however, Nutricote leads to overall better seedling growth, especially when paired with Sunshine Mix. More research is needed to optimize the use of tankage as a seedling fertilizer.

## **Acknowledgements**

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