# A Novel Organic Soil Amendment with Consistent Composition Promotes Soil Microbial Respiration and Growth of Horticultural Plants

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## Introduction

- **Plants compete & cooperate with soil microorganisms**
  - For nutrients such as N, P or Mg etc.
  - Microorganisms affect nutrient cycling[1,3,6]
    - Net mineralization ↑ soil nutrients for plants
    - Net immobilization ↓ soil nutrients for plants
    - Fertilizers and composts impact nutrient cycling
- **Design of novel soil amendment: C20™**
  - Food for microorganisms in the soil
  - C:N ratio 20:1 to support mineralization of soil nutrients[6]
  - Consistent formulation for consistent performance
  - Lasting nutrition - 1 application per season (or less)
- **Specific Objectives:** Evaluate ability of C20™ to:
  - Stimulate microbial activity in soil
  - Support plant growth: Manhattan 5 Rye Grass*
  - Support growth for longer than lawn starter fertilizer

*a radish study has also been completed (see supplement)

## Materials and Methods

### Soil Respiration Experiment

- Uses Providence Academy clay subsoil* MWL soil analysis report available
- 4 treatments, 6 replicates in standard soil respiration experiment in Mason jar with $CO_2$ trap[2,4,5]
  - soil only (control group)
  - soil + C20™
  - soil + compost
  - soil + fertilizer
- $CO_2$ traps were removed for each data point (day) collected and replaced to continue collecting data on respiration activity for 3+ months

### Manhattan 5 Rye Grass Experiment

- Used Providence Academy clay top soil*
- 100 Rye Grass seeds planted per 4x4 pots; grown in indoor GrowLab
- 4 treatments, 8 replicates
  - soil only control
  - C20™ applied once at the beginning at 1% v/v
  - C20™ applied once at the beginning at 2% v/v
  - lawn starter fertilizer applied every once every six weeks
- watered equally initially and as needed as plants grew larger

*MWL soil analysis report available

## Results

**soil = soil only control** **C20™ = novel soil organic amendment** **comp = compost** **fert = fertilizer**

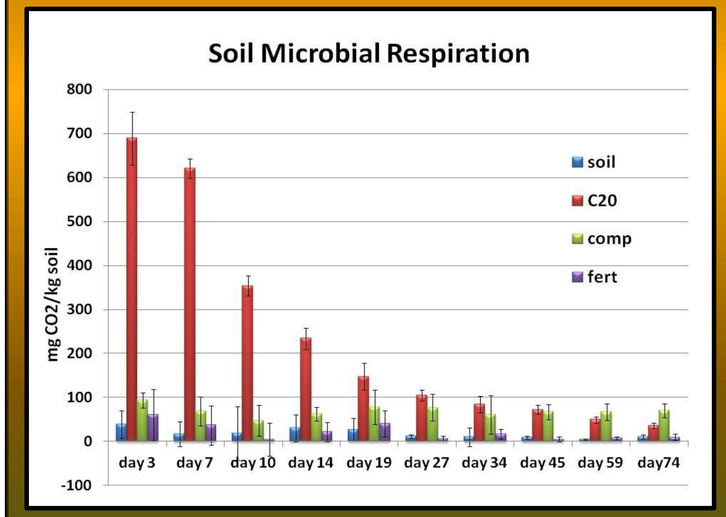


**Figure 1: Microbial Soil Respiration above soil only**

- C20™ promotes the most microbial respiration
- compost promotes lower but steady microbial respiration
- fertilizer does not promote microbial respiration in soils
- P values ranged from $1.22 \times 10^{-11}$ - $5.1 \times 10^{-14}$

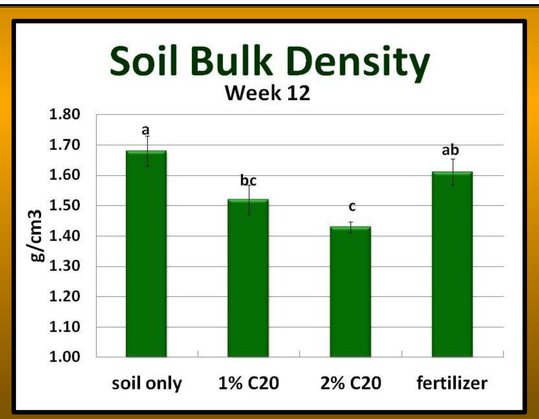


**Figure 2: Soil Bulk Density**

- 2% C20™ significantly reduced soil bulk density
- fertilizer did not reduce soil bulk density
- P = 0.0017

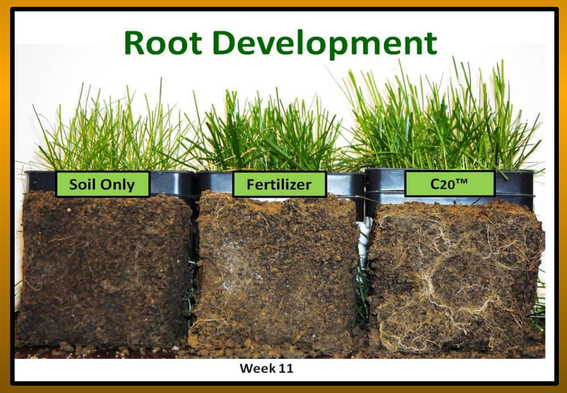


**Figure 3: Root Development**

- 2% C20™ treated rye grass developed more roots* than all other treatments (visual inspection)
- fertilizer did not enhance root development over the control

* Radish experiment produced similar results (see supplement)

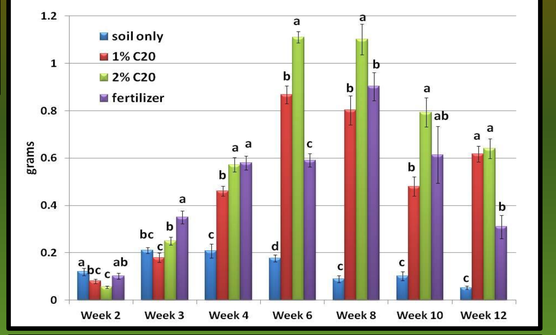


**Figure 4: Weekly Growth of Rye Grass**

- 2% C20™ promoted the greatest grass growth
- 1% C20™ & fertilizer promoted growth over soil fertilizer required reapplication; C20™ did not
- P values ranged from 0.002 (wk 2) - $<2e^{-16}$ (wk 6)

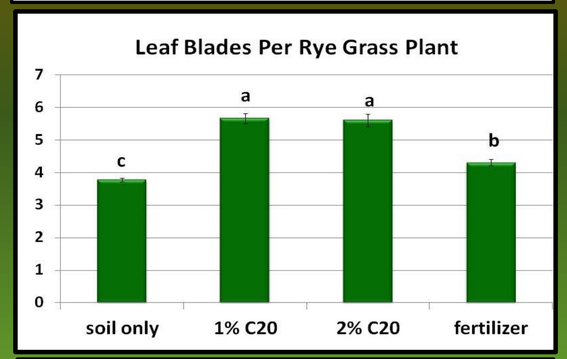


**Figure 5: Thickness of Rye Grass**

- C20™ treated soils produced rye grass plants with more leaves per plant
- fertilizer out performed soil only but not C20™
- C20™ had more grass plants per pot at the end of the experiment
- P < $2e^{-16}$


## Discussion & Conclusions

- **C20™ promotes stem and leaf growth above fertilizer in radishes & rye grass**
  - C20™ can support thicker turf grass growth with fewer applications than fertilizer
- **C20™ promotes improved soil structure & permits more robust root development**
  - C20™ treated turf grass may be more resilient to drought stress…future studies
- **Does C20™ promote in situ growth of soil microorganisms or bring in microbes?**
  - Preliminary data suggests both
  - Different soils treated with C20™ produce different fungal fruiting bodies & odors
  - Wet C20™ alone produces $CO_2$ in respiration jar
- **Does C20™ promote initial immobilization of nutrients?**
  - The observation that Manhattan 5 Rye grass and radish plant* growth lags behind fertilizer and soil only treated samples is consistent with the hypothesis that C20™ promotes initial immobilization
- **A shift to mineralization after 2-3 weeks?**
  - Since both Manhattan 5 Rye grass and radish plants growing in the presence of C20™ caught up to and surpassed the growth of fertilizer treated plants, C20™ must be enhancing mineralization of nutrients in plant accessible "pools" in the soil

*see supplement for data from the radish study

## References

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