The Effect of Spent Coffee Grounds on Germination and Growth of Container Grown Specialty Crops

PRESENTER:
Amanda Birnbaum
abirnbaum@tamu.edu

TEXAS A&M UNIVERSITY

CENTER FOR COFFEE RESEARCH & EDUCATION

Composted SCG (CSCG) May Be a Beneficial Replacement for Peat Moss

BACKGROUND: As coffee consumption increases, so does the amount of SCG, creating a waste management issue. Coffee consumption was about 9.3 billion kg in 2016 (McNutt and He, 2019). Spent Coffee grounds constitute 45-50% of the waste produced from coffee consumption, and often pose environmental hazards from runoff when put in landfills (Janissen et al., 2018).

The increase in demand has resulted in an explosion of large coffee beverage companies. One of the largest cold brew coffee companies in North America is in San Antonio, TX. In 2017, they produced 40 cubic yards of SCG a day (Figure 1), and project that amount to increase exponentially.

Using SCG as a potting mix amendment would remove substantial amounts of waste from landfills and give growers another viable alternative to sphagnum peat moss.

Fig. 1: Dumpsters of SCG generated from cold-brew coffee production

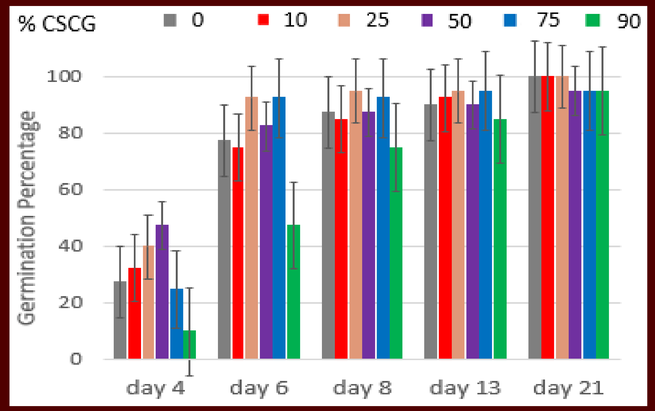
The role of SCG as potting mix amendment is promising. They out rank many other organic waste products in terms of chemical and physical suitability for agronomic and horticultural uses. Spent coffee grounds have large amounts of organic matter, high mineral content, suitable pH range of 5.6-6.8, and a low carbon to nitrogen ratio (Figure 2). By diverting SCG from landfills and using them as an addition to media in place of peatmoss, we are decreasing CO_2 emissions, creating sustainable practices and a circular economy.

Functional Properties	Spent Coffee Grounds	Canadian Sphagnum Peat Moss (professional grade)[a]
Water holding capacity (g/g water/dry sample)	5.73[d]	10 – 14
pH	5.6 – 6.8[c,d]	3.5 – 3.8
Organic Matter (%)	90.5[b]	98 – 99
Carbon:Nitrogen	20 – 25:1[b,c]	48 – 54:1

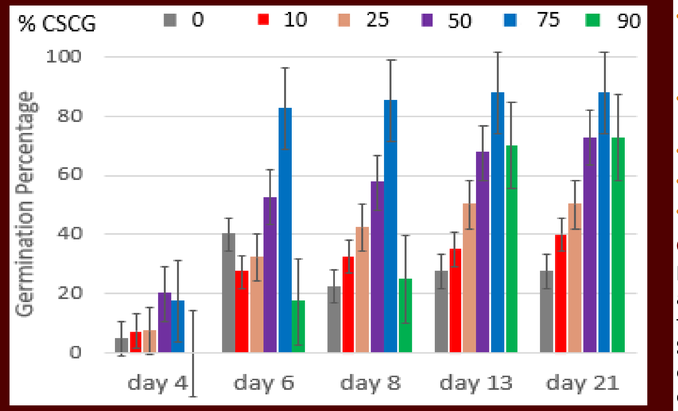
Fig. 2: Functional properties of peat moss versus non-composted SCG.

Theriault-hachey.com[a]; Stylianou et al., 2018[b]; Flores et al. 2020(unpublished)[c]; Ballesteros et al. 2014[d]

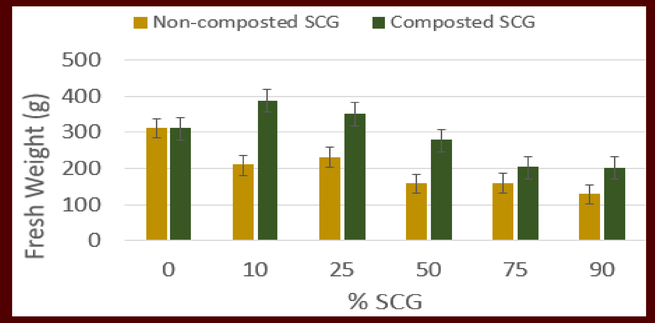
Pea germination was stimulated at 50% CSCG



Spinach germination was greatest at 75% CSCG



Biomass of eggplant was greatest in 10% CSCG



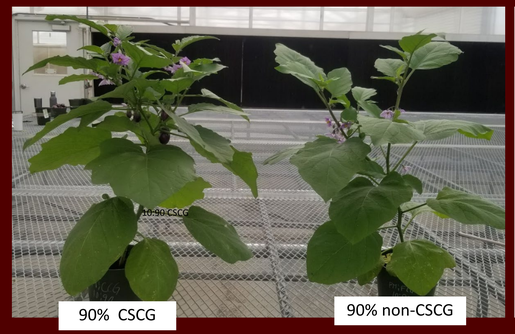
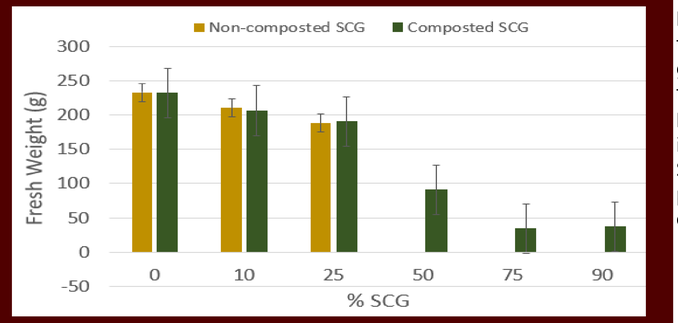


Fig. 3: Size and development difference in eggplants at 90% CSCG and non-CSCG. Fresh weight when grown in CSCG was greater than in peat alone or non-CSCG in as much as 50% CSCG.

Basil died in non-composted SCG >25%



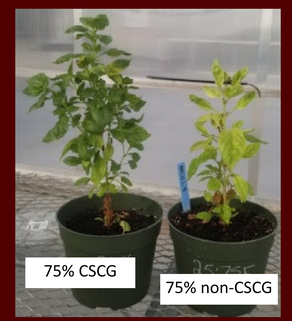


Fig. 4a: Size and development difference in basil at 75% CSCG and non-CSCG. Fresh weight was not significantly different in up to 25% SCG.
Fig. 4b: Tip death in basil at >25% non-composted SCG.

METHODS: This study was conducted at the Horticulture Teaching Research and Education greenhouses

- 2 Media types:
  - potting mix with non-composted SCG
  - potting mix with composted SCG
- 5 Ratios (v/v); 90:10, 75:25, 50:50, 25:75, 10:90, and the control 0 SCG
- 1 Fertilizer rate (15-5-25); High 0.4 g/L (400 ppm)
- 5 Replicates/treatment growth experiment
- 40 seeds/treatment germination experiment/3 replicates

GERMINATION RESULTS AND CONCLUSIONS

Peas: There were no significant differences among treatments at day 21. Day 4 emergence was significantly greater in 50:50 treatment than higher rates of CSCG.
Spinach: Germination percentage was significantly lower in control at day 21 compared to all other treatments. Day 6 emergence was significantly greater in 75% CSCG compared to all other treatments. Addition of CSCG results in possible increased germination for peas and spinach.

GROWTH RESULTS AND CONCLUSIONS

Eggplant: Eggplant fresh weight is significantly higher in CSCG than non-CSCG across all treatments. Non-CSCG reduced growth and stunted development in all treatments compared to CSCG.

Basil: There was no significant differences in fresh or dry weight in treatments <50% SCG. Basil plant died in treatments >50% SCG. Differences between CSCG and non-CSCG could be due to phytotoxicity, which is removed after composting. Calcium deficiency could cause tip death.

Mineral Nutrient	Non-CSCG	CSCG
% N	2.2	3.4
% C	50.5	48.8
C:N	23.1	14.3

Fig. 5: Comparison of C and N in CSCG and non-CSCG. The C:N is much lower in the CSCG which may indicate greater N availability.

FUTURE RESEARCH

- Growth and germination of other plant species in CSCG
- Measure N and pH overtime
- Try different composting procedure to improve C:N
- Evaluation of microbial communities and diversity in SCG
- Characterization of the classes of compounds making up SCG

REFERENCES

Amanda L. Birnbaum[1*], Grace Bodine[2], Morgan Holland,[3] and David W. Reed[1]
[1]Horticultural Sciences, Texas A&M University; [2]Soil and Crop Sciences, Texas A&M University; Food Science and Technology[3], Texas A&M University; *abirnbaum@tamu.edu