Spent Coffee Grounds Have a Biostimulant Effect on Germination of Spinach, Peas, and Radish

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Background

As coffee consumption increases, so does the amount of spent coffee grounds (SCG), creating a waste management issue. Spent Coffee grounds constitute 45-50% of the waste produced from coffee consumption, and often pose environmental hazards from runoff when large quantities are put in landfills (Janissen et al., 2018). The increase in demand has resulted in an explosion of 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, pictured in Figure 1, and project that amount to increase exponentially.

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

Using SCG as a media amendment would divert substantial amounts of them from landfills and give growers a viable alternative to sphagnum peat moss. Compared to sphagnum peat moss, SCG have comparable amounts of organic matter, mineral content, ideal pH range, and carbon to nitrogen ratio. When SCG are composted the above-mentioned attributes are improved, as seen in Table 1 (Gomes, 2013; Liu and Price, 2011; Ronga *et al.*, 2016). Additionally, the composting process ensures the breakdown of phytotoxic compounds and promotes nitrogen mineralization.

Chrysargyris *et al.* 2019, tested germination of brassica seeds in mixtures of peat and SCG of 2.5, 5, and 10%. They found cabbage germination was stimulated at 2.5% SCG and cauliflower at up to 5%. At 10% SCG the percent germination decreased but mean emergence time increased. They concluded that up to 5% SCG could be used as a biostimulant and or partial peat replacement for brassica seedlings. Our study showed similar results, which also varied by plant species. By composting the SCG before using them, we were able to use up to 90% with minimal evidence of toxicity.

Methods

- Fresh SCG were composted for three months using an EcoDrum®, seen in Figure 2, which is designed for composting bulk, whole chicken carcasses.
- Temperatures ranged from 45 to 60°C, and water was added as needed to maintain moisture.
- When the temperature was < 45 °C the composted SCG were removed and stored in barrels for a one month curing period.

Fig. 2: Barrels of SCG from a cold brew coffee manufacturer were loaded into the Ecodrum® daily, for three consecutive days.

Composted SCG May Be a Beneficial Replacement for Peat Moss

Table 1. Comparison of the functional properties and mineral nutrients of SCG, composted SCG, and commercial grade sphagnum peat moss.

	Non-Composted SCG	Composted SCG	Sphagnum Peat moss[a]
% OM	90.5	90.5	98-99
C:N	20	14	48-54:1
pH	5.5	5.3	3.5-3.8
EC (µS/cm)	1.53 e+3	1.58 e+3	< 400
% N (dry wt.)	2.2	3.7	0.8-1.0
% P (dry wt.)	0.1	0.1	0.01-0.3
% K (dry wt.)	0.5	0.6	0.01-0.2
% Ca (dry wt.)	0.2	0.3	0.1-0.25
% Mg (dry wt.)	0.1	0.2	0.1-0.2

[a]Theriault-hachey.com

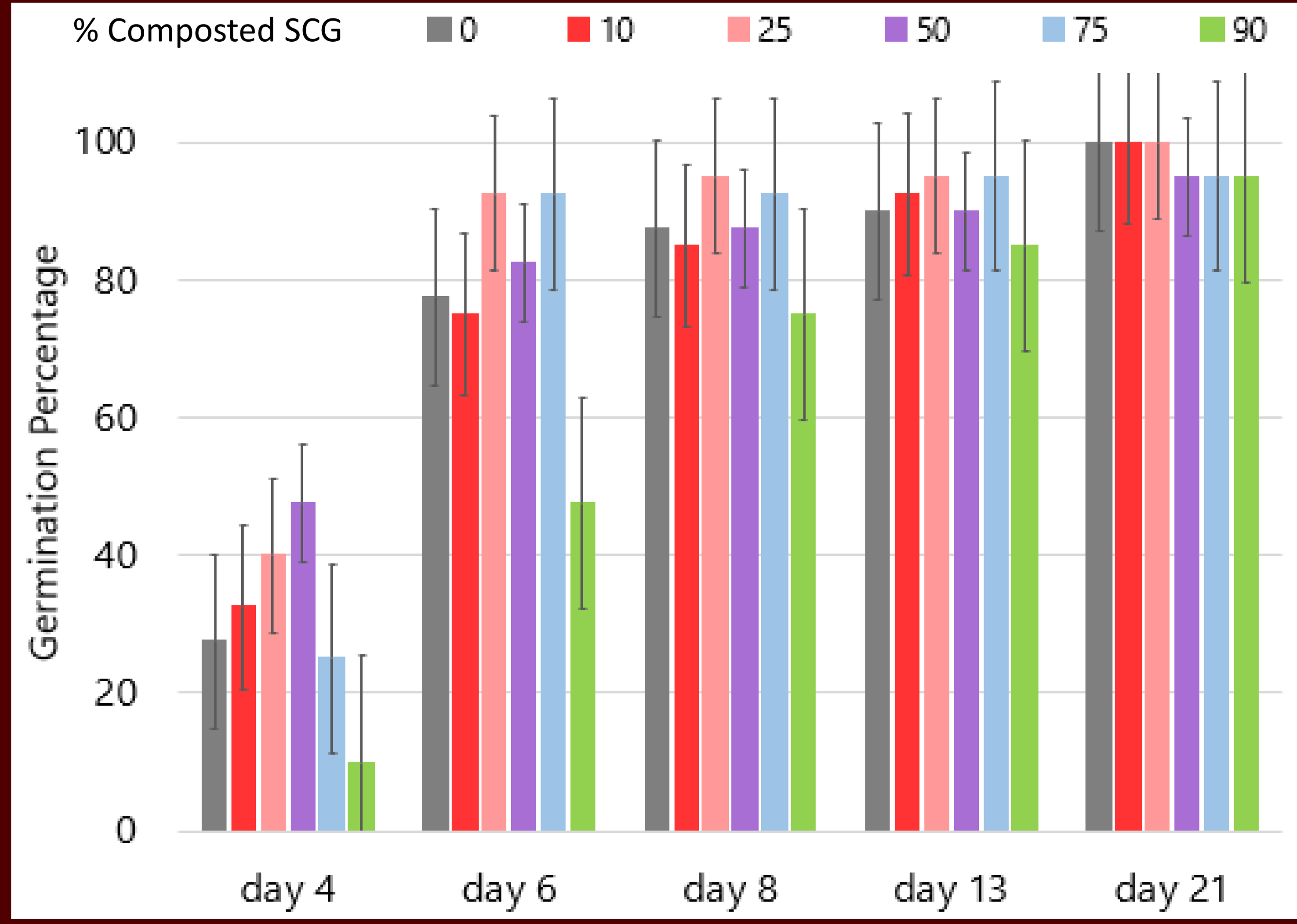

Figure 3. Effect of percent composted SCG on pea (*Pisum sativum* 'Wando' bush peas) germination over three weeks. Bars represent standard error of the mean.

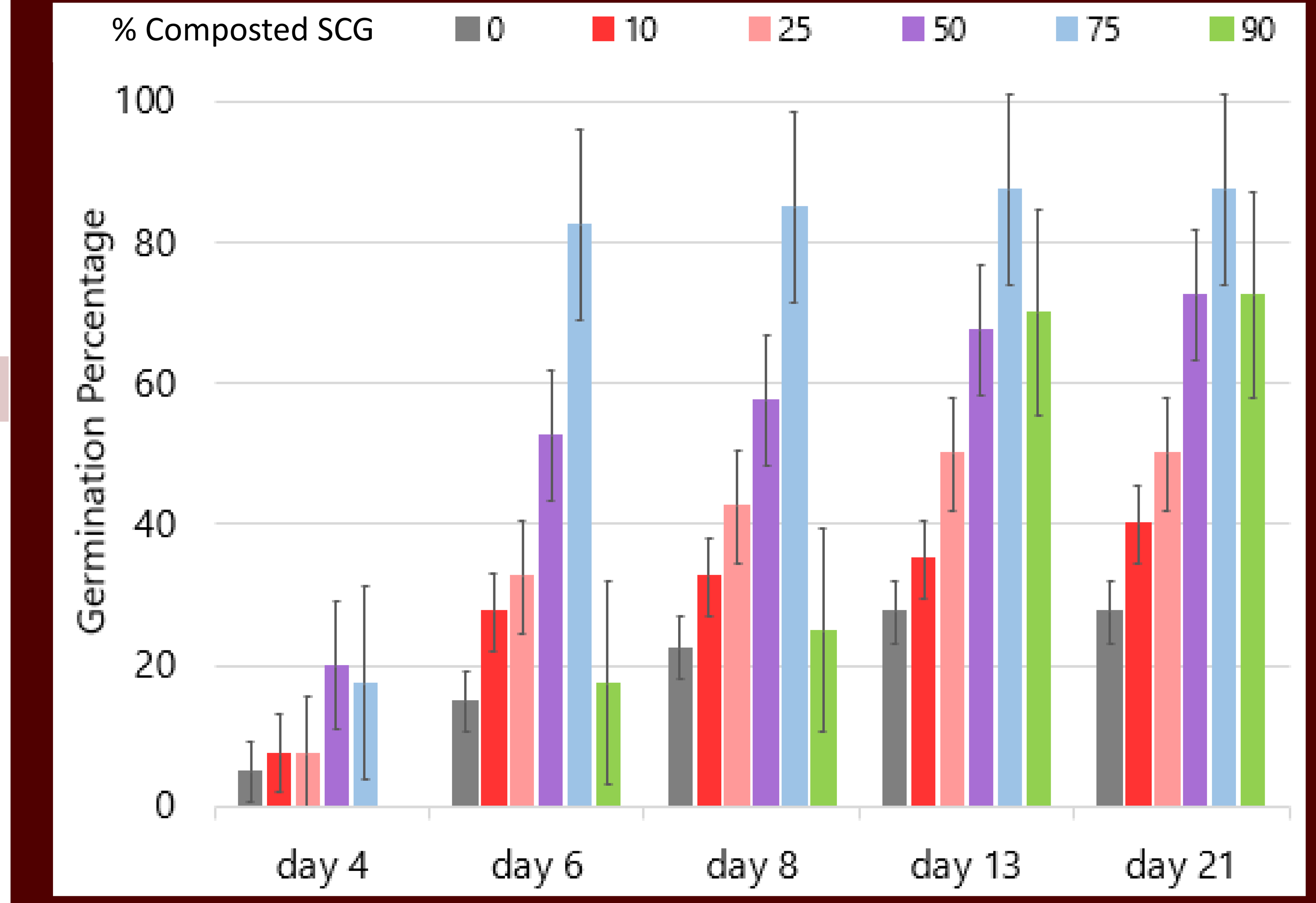

Figure 4. Effect of percent composted SCG on spinach (*Spinacia oleracea* hybrid #7) germination over three weeks. Bars represent standard error of the mean.

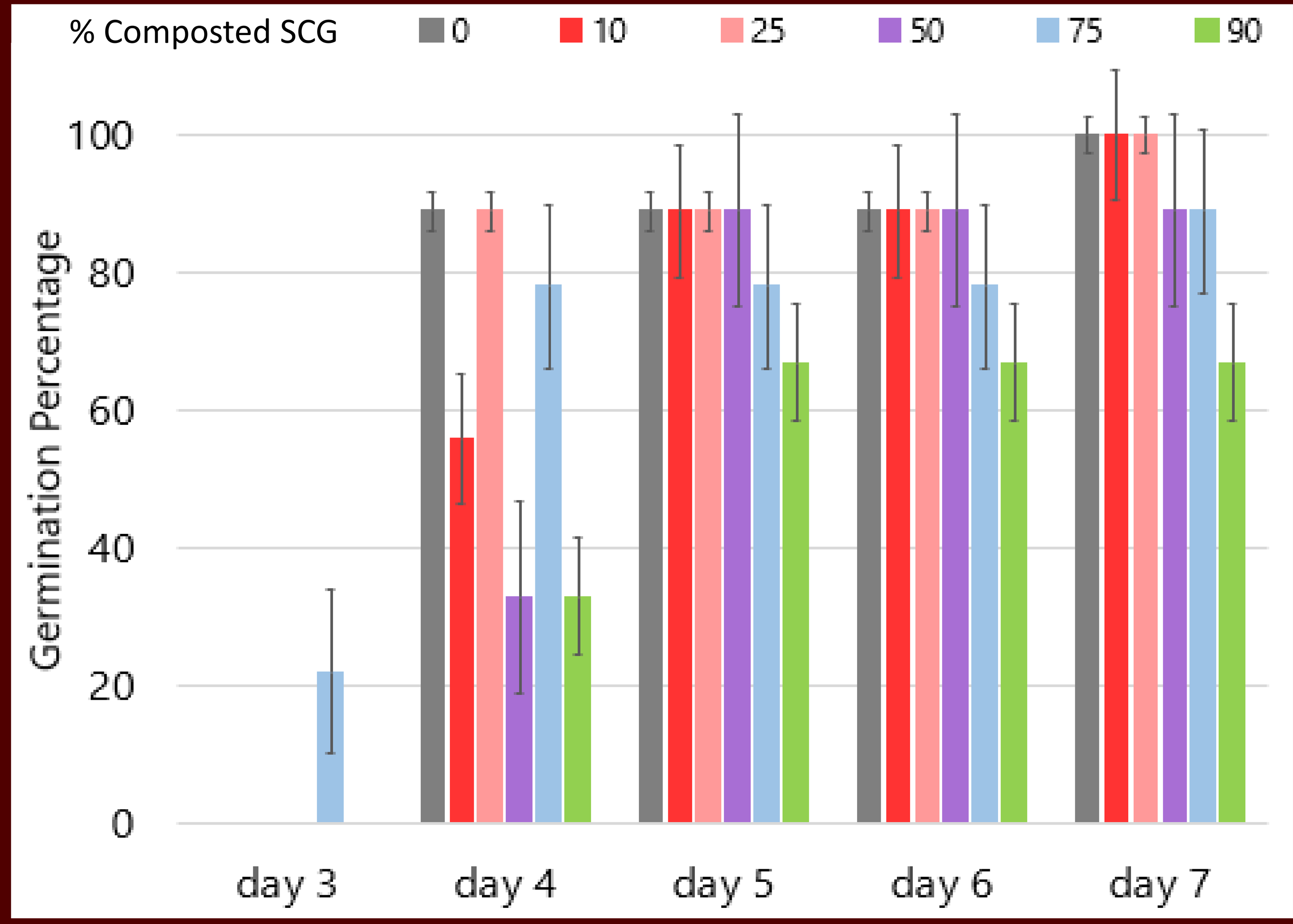

Figure 5. Effect of percent composted SCG on radish (*Raphanus sativus* 'Cherry Belle') germination over one week. Bars represent standard error of the mean.

Methods

- Germination treatments (composted SCG:potting mix) included 90:10, 75:25, 50:50, 25:75, 10:90, and the control 0:100.
- Pro-mix LP15 potting mix was used in all experiments (80-90% peat moss, 10-20% perlite).
- Plant varieties used were *Pisum sativum* 'Wando' bush peas, shown in Figure 6; *Spinacia oleracea* hybrid #7 spinach; and *Raphanus sativus* 'Cherry Belle' radish.
- There were 40 seeds per tray per plant species, and each treatment was replicated three times.
- Trays were placed in a complete randomized design on misting benches and watered at regular intervals.

Fig. 6: Pea germination in 75:25 (composted SCG:PM).

Results

Peas (Fig. 3): There were no significant differences in percent germination among treatments at day 21, which indicates there is no inhibitory or stimulatory effects from the composted SCG after this time period.

Day 4 emergence appears to have been stimulated in the 50:50 treatment, however that difference disappears over time. For days 4-6, the 90:10 had lesser germination, but that difference disappeared over time.

Spinach (Fig. 4): Germination percentage was significantly lower in the control compared to all other treatments at day 21. Germination in spinach appears to be stimulated in composted SCG treatments of up to 75%. At day 13 the inhibitory effect seen in the 90:10 treatment diminishes, with only a slight effect by day 21.

Day 6 emergence was significantly greater in 75% composted SCG compared to all other treatments. Addition of composted SCG at a rate of 75:25 appears to have the greatest stimulatory effect.

Radish (Fig. 5): The 75% composted SCG treatment exhibited stimulation in germination one day earlier, at day 3, than all other treatments. Final germination may have been inhibited at 90% composted SCG.

Conclusions

- Treatments of up to 75% composted SCG showed no inhibitory effects on germination, and in the case of spinach, stimulated germination in the first eight days.
- Spinach germination increased with increasing percent composted SCG up to 75%.
- Germination was stimulated in the first 3 (radish) or 4 (spinach, peas) days with the addition of composted SCG.
- Composted SCG can be used as a partial replacement for peat and may decrease days to germination.

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References