Mineralization and CO_2 Dynamics of Spent Coffee Grounds Over Two Different Incubation Periods

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INTRODUCTION

Thousands of tons of spent coffee grounds (SCG) are sent to landfills each year, and with the recent growth in cold-brew coffee production (Figure 1) this is expected to increase. Waste utilization is a key component to sustainable agriculture and creating a circular economy. The use of SCG in agriculture can improve soil properties and plant growth by increasing organic matter and nutrients. In this experiment we investigated the use of non-composted and composted SCG (CSCG) as a source of ammonium and nitrate.

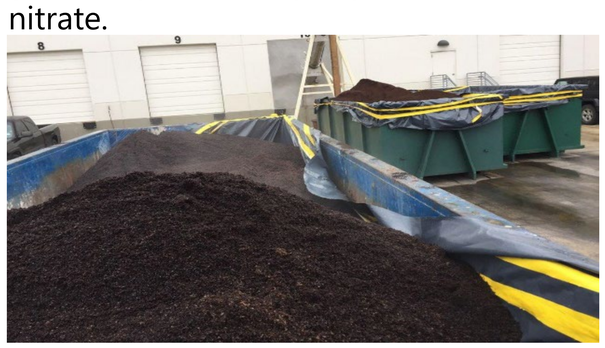

Fig. 1: Dumpsters of SCG generated from cold- brew coffee production

When CSCG were used to amend sand root zones (Figure 2), water holding capacity, shoot growth, and leaf tissue N content were greater compared to peat moss and sand alone (Flores et al., 2020).

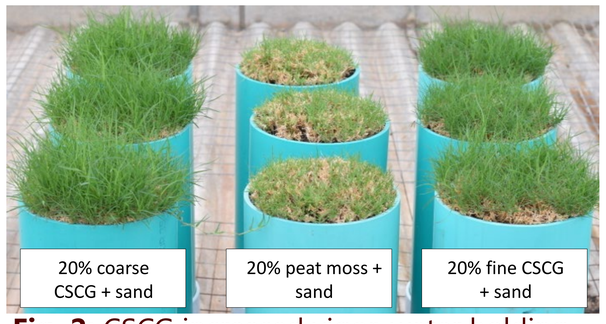

Fig. 2: CSCG increased vigor, water holding capacity, shoot growth, and leaf N, compared to peat moss and sand alone

OBJECTIVE

Determine the mineralization and respiration rate of composted and non-composted SCG after an incubation period of 70 and 100 days.

METHODOLOGY

- Non-composted SCG, composted SCG, Milorganite (5-2-0), and urea (46-0-0) fertilizers were mixed into 50 g of a fine-sandy loam field soil at 9.8 g N m^{-2}
- Microcosms were held at 25°C for 100 days and sampled every 10 days for
  - Soil NH_4^+-N and NO_3^--N (Keeney and Nelson, 1982)
  - CO_2 (Franzluebbers et al., 2000)
  - Total inorganic N is the sum of NH_4^+-N + NO_3^--N

Table 1: Chemical properties of non-CSCG, CSCG, and soil used in the 70- and 100-day incubations. Inorganic N represents ammonium-N + nitrate-N.

	Non-composted SCG	Composted SCG (70 d)	Composted SCG (100 d)	Soil
% N	2.2	2.9	3.9	0.1
% organic C	51	49	46	1.3
C:N	23:1	14:1	13:1	13:1
pH	5.5	4.7	5.3	4.7

RESULTS

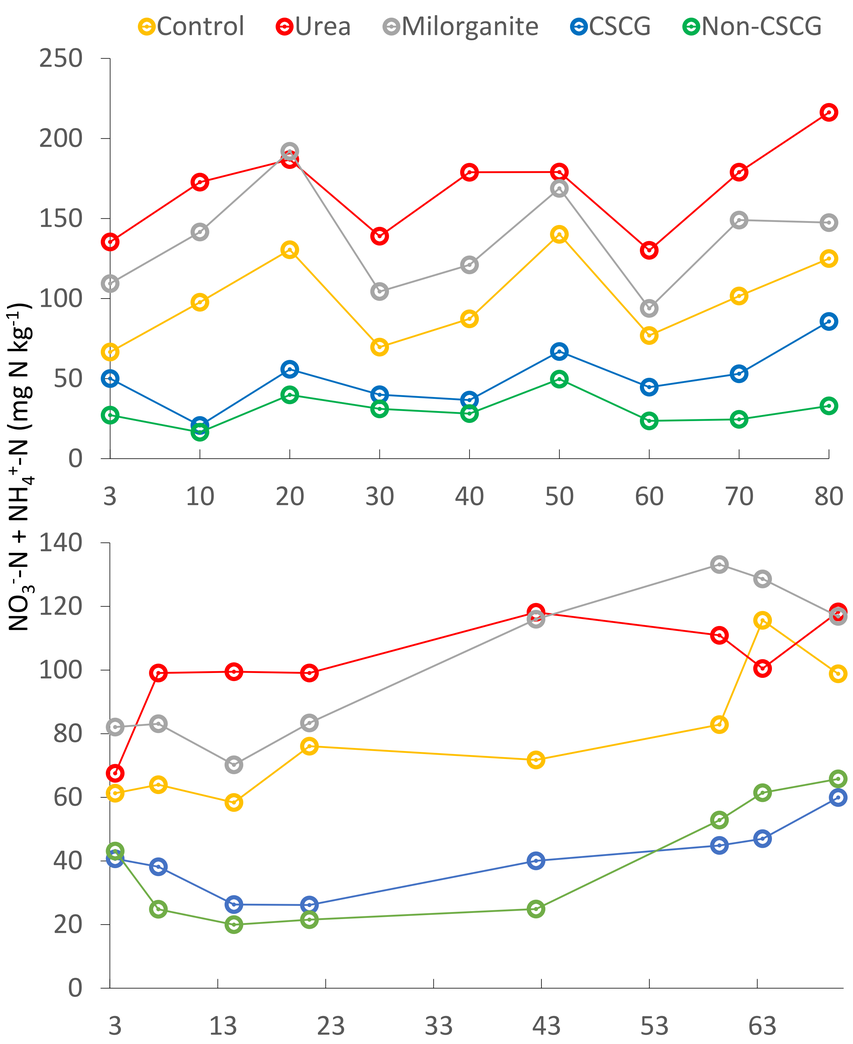

Fig. 3: Total inorganic N concentration extracted from soils over a 100- (top) and 70-day (bottom) incubation.

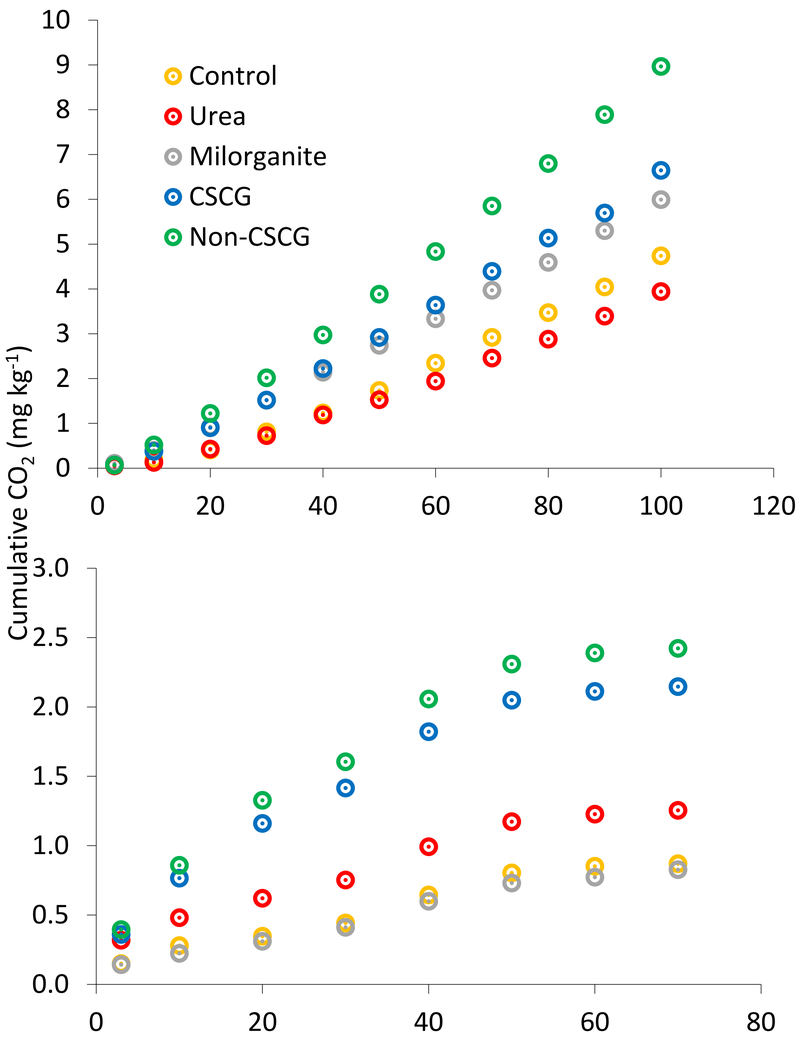

Fig. 4: Cumulative CO_2 concentration over a 70- (left) and 100-day (right) incubation.

- Total inorganic N was lower in both CSCG and non-CSCG than the control throughout both incubation periods, adding no N to the system (Figure 3).
- There was some mineralization of the SCG in the 70-day incubation beginning at day 43.
- Greater CO_2 respiration was observed with SCG suggesting active microbial activity is required for the breakdown of SCG relative to other treatments (Figure 4).
- The milorganite and CSCG had very similar CO_2 respiration in the 100-day incubation, but not in the 70-day incubation.
- Incubations differed, which may be due to variability in the SCG or soil.

CONCLUSIONS

- SCG may serve as a long-term fertilizer due to the time it takes to mineralize.
- SCG may increase the nutrient and water holding capacity of soil, which can improve plant growth over a shorter time period.

REFERENCES

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