



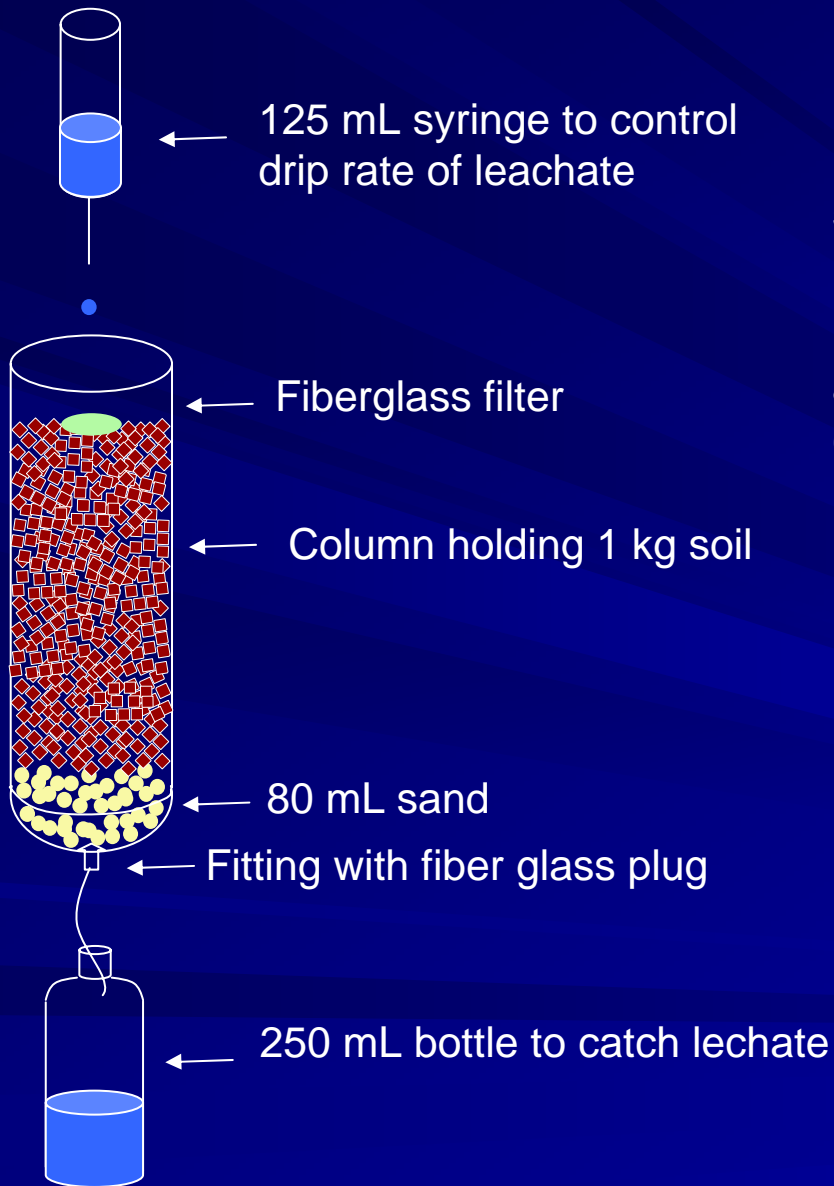
# Impact of Soil Biochar Applications on Nutrient Leaching

David A. Laird, Pierce Fleming, and Doug Karlen  
USDA, ARS, National, Soil Tilth Laboratory

Robert Horton  
Department of Agronomy, Iowa State University

Baiqun Wang  
Institute of Soil and Water Conservation, Yangling, China

# Experimental design



Biochar: 0, 5, 10, and 20 g kg<sup>-1</sup>  
Initial bulk density ~1.1 g cm<sup>-3</sup>  
Leached weekly with 200 mL 0.001 M CaCl<sub>2</sub>  
5 g dry swine manure (3.9% N) added week 12

Measure: NO<sub>3</sub>, Na, Mg, Ca, K, Si, Cu, Zn, B, and P in the leachate; and total C, N, pH, and CEC at end.

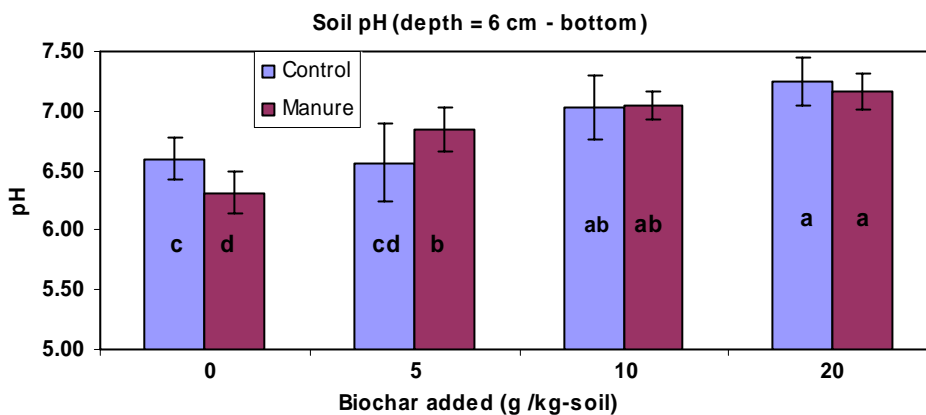
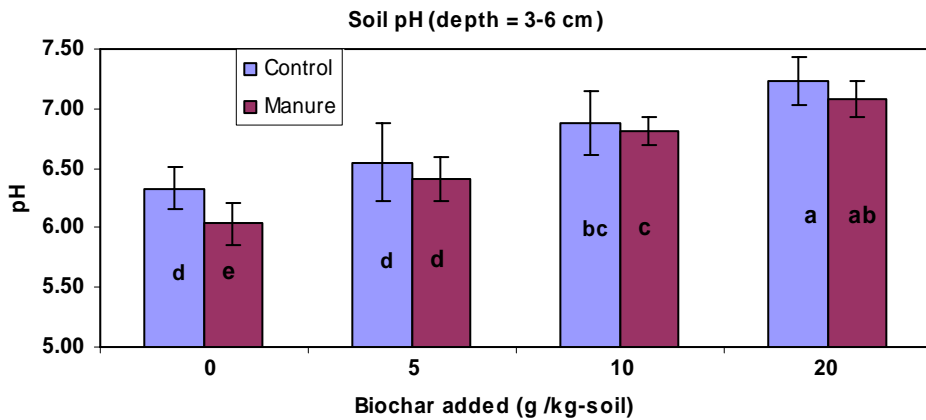
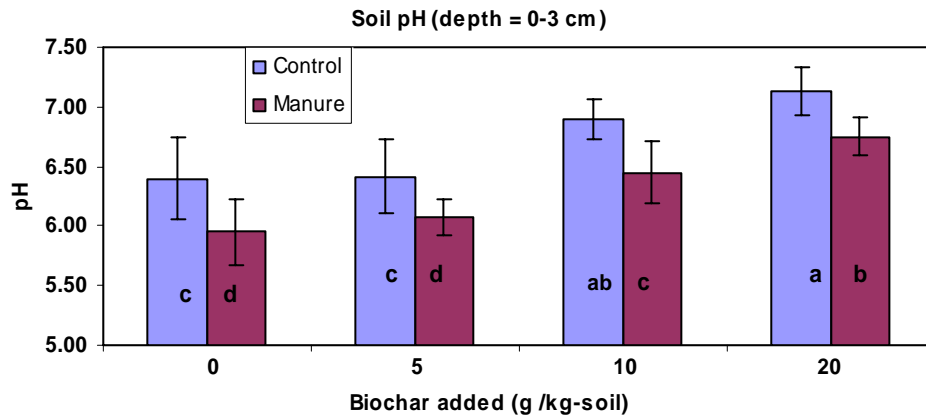


# Impact of Biochar on Soil pH

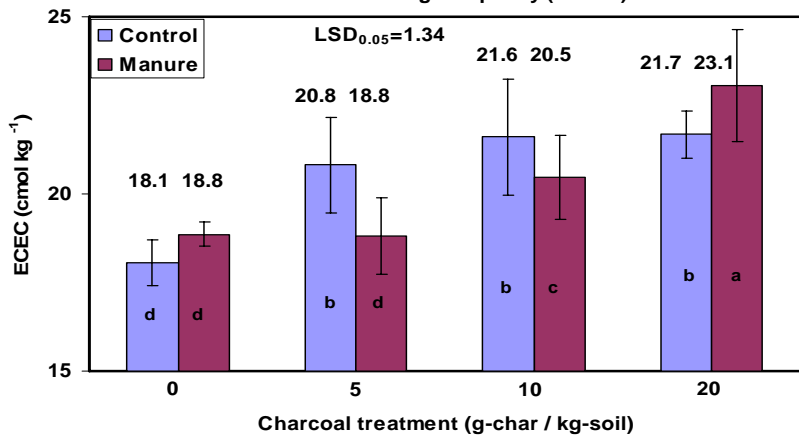
Ash content of biochar = 7.5%

Assuming the ash is CaO then:

$$\text{CCE} = 12.5$$



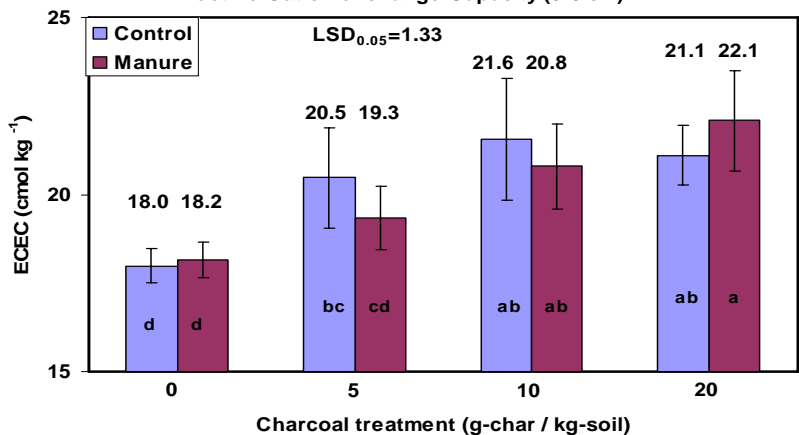
Effective Cation exchange Capacity (0-3 cm)



## Percent change in ECEC (0-3 cm)

<u>Char added (g/kg)</u>	<u>Control</u>	<u>+Manure</u>
0	0	4
5	15	4
10	20	13
20	20	28

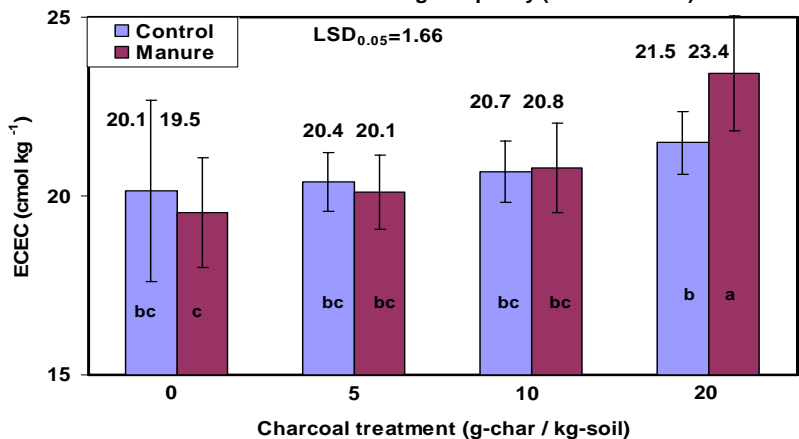
Effective Cation exchange Capacity (3-6 cm)



## Percent change in ECEC (3-6 cm)

<u>Char added (g/kg)</u>	<u>Control</u>	<u>+Manure</u>
0	0	1
5	14	7
10	20	16
20	17	23

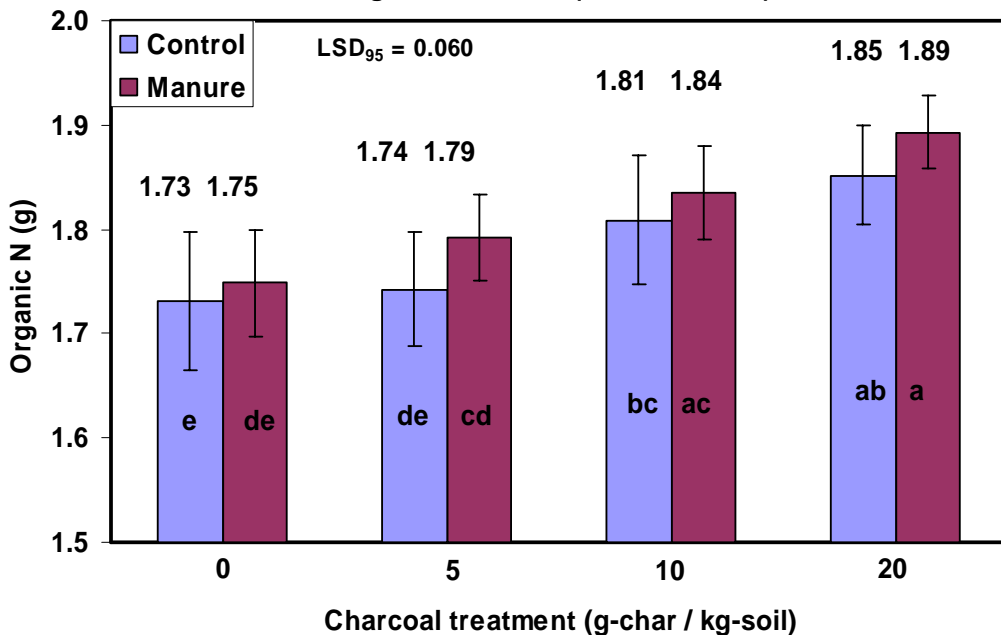
Effective Cation exchange Capacity (6 cm - bottom)



## Percent change in ECEC (6 cm – bottom)

<u>Char added (g/kg)</u>	<u>Control</u>	<u>+Manure</u>
0	0	-3
5	1	0
10	3	3
20	7	16

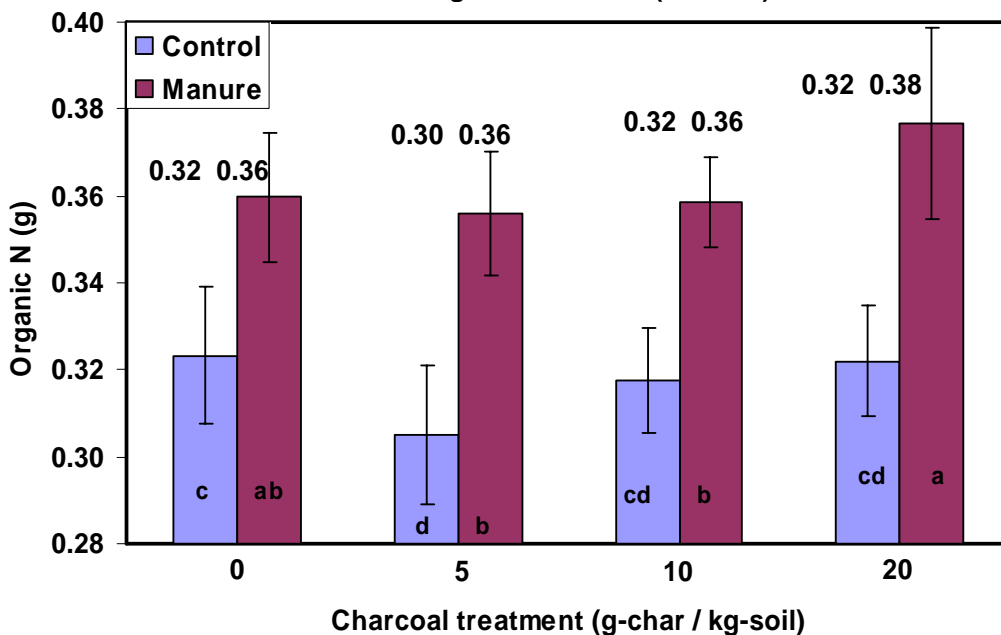
Organic N in Soil (whole column)



Recovery of biochar N whole column

<u>Char added (g/kg)</u>	<u>N recovery (%)</u>
0	-
5	31
10	108
20	84

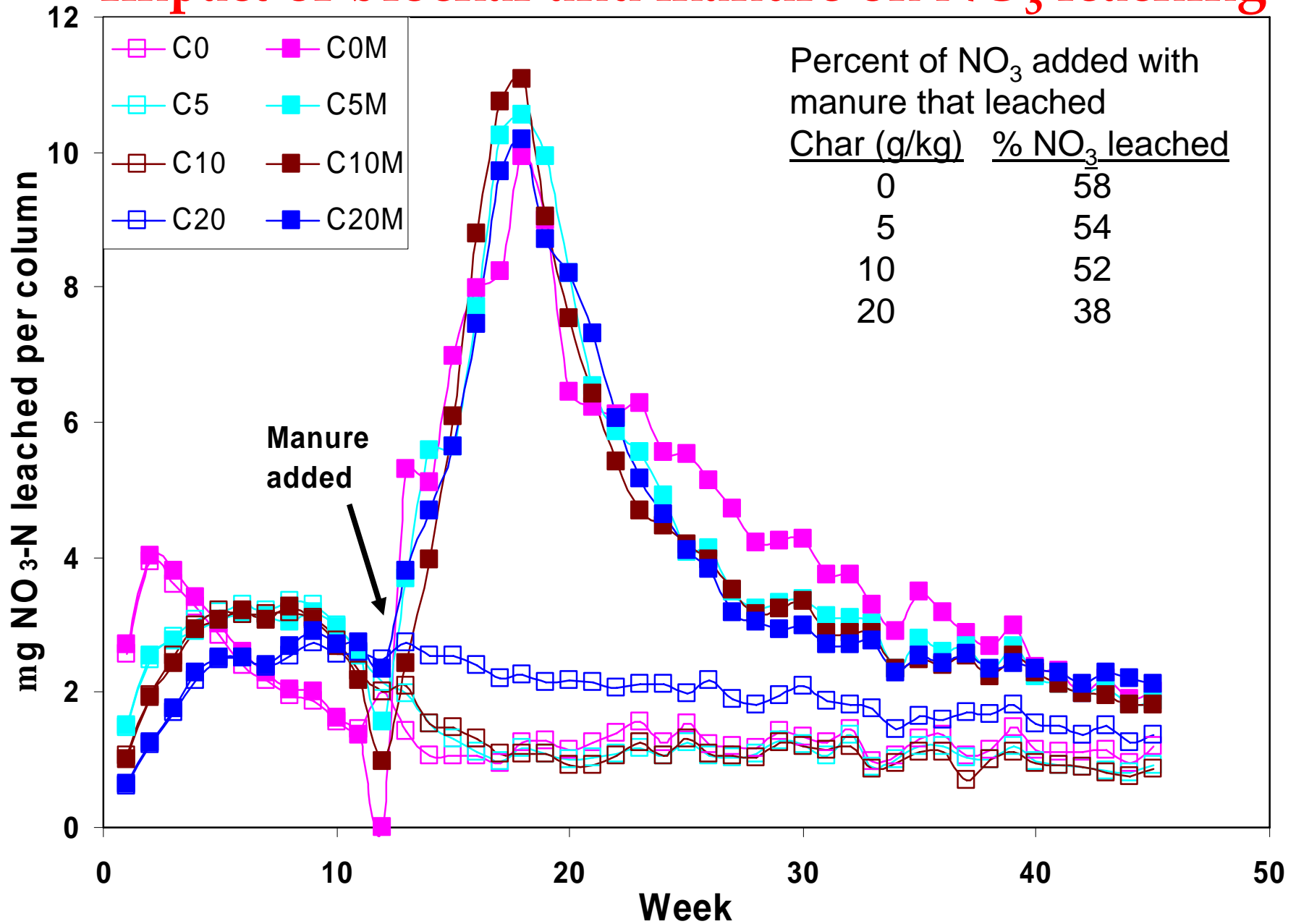
Organic N in Soil (0 - 3 cm)



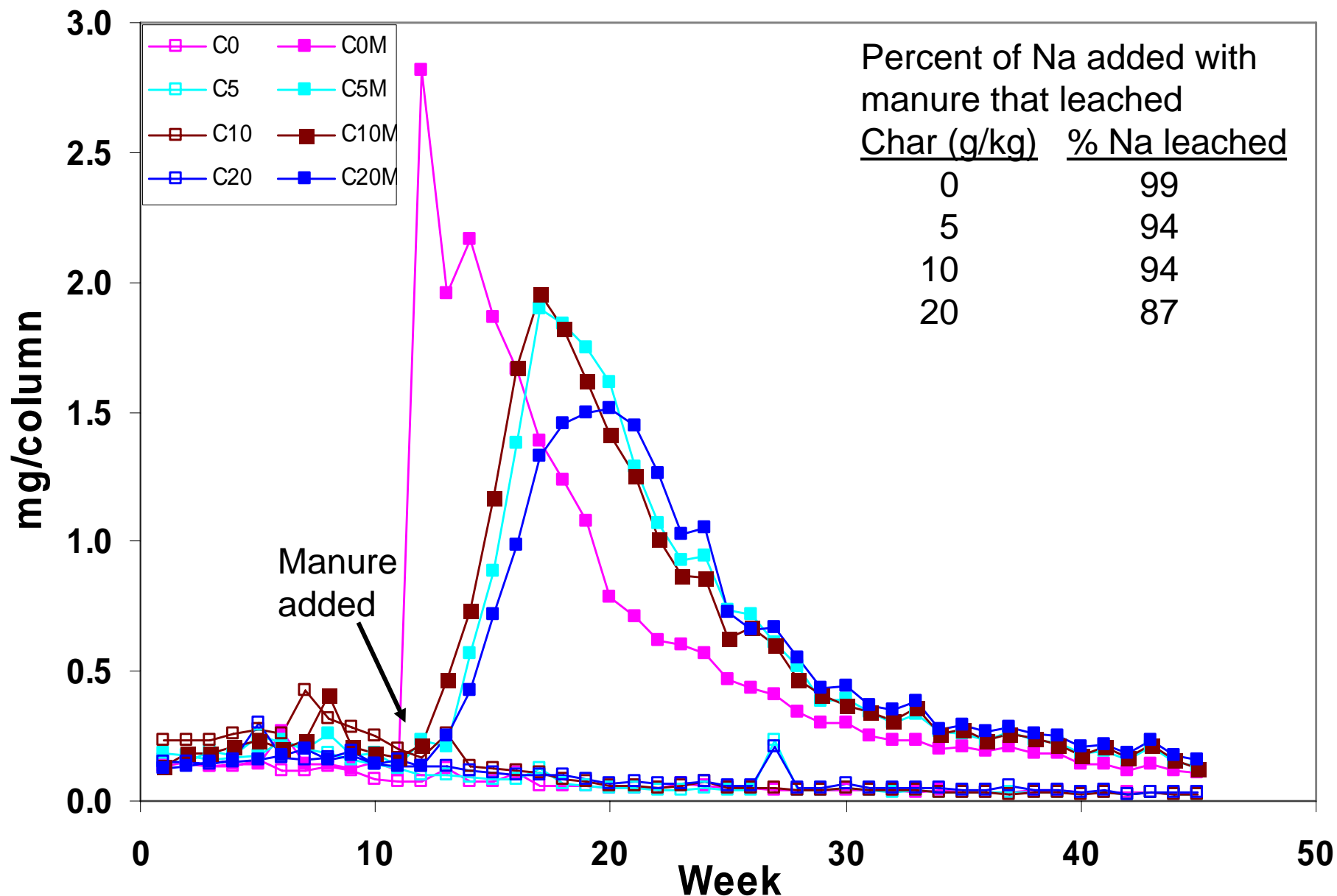
Recovery of manure N in 0-3 cm

<u>Char added (g/kg)</u>	<u>N recovery (%)</u>
0	21
5	29
10	23
20	31

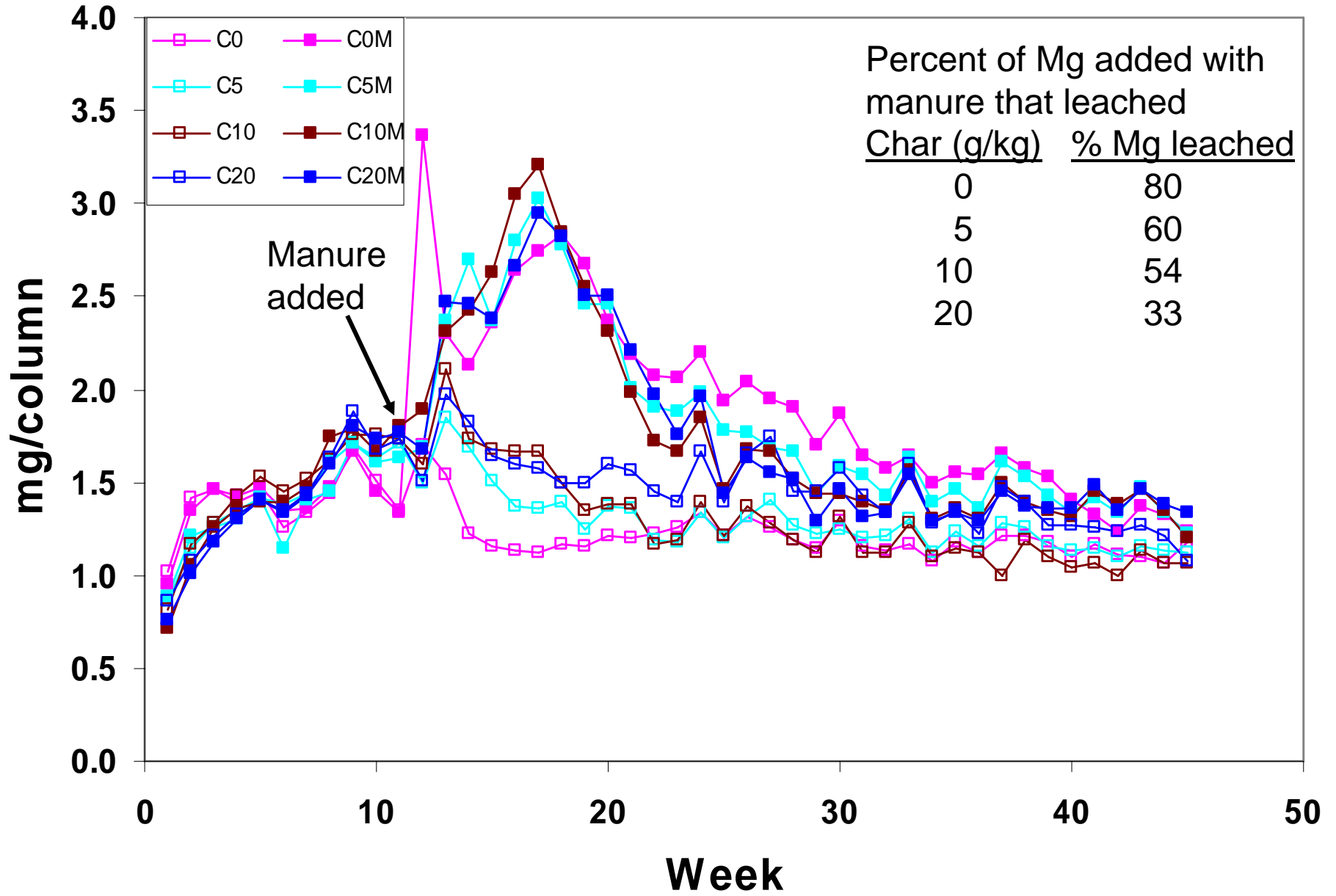
# Impact of biochar and manure on NO<sub>3</sub> leaching



# Impact of biochar and manure on Na leaching

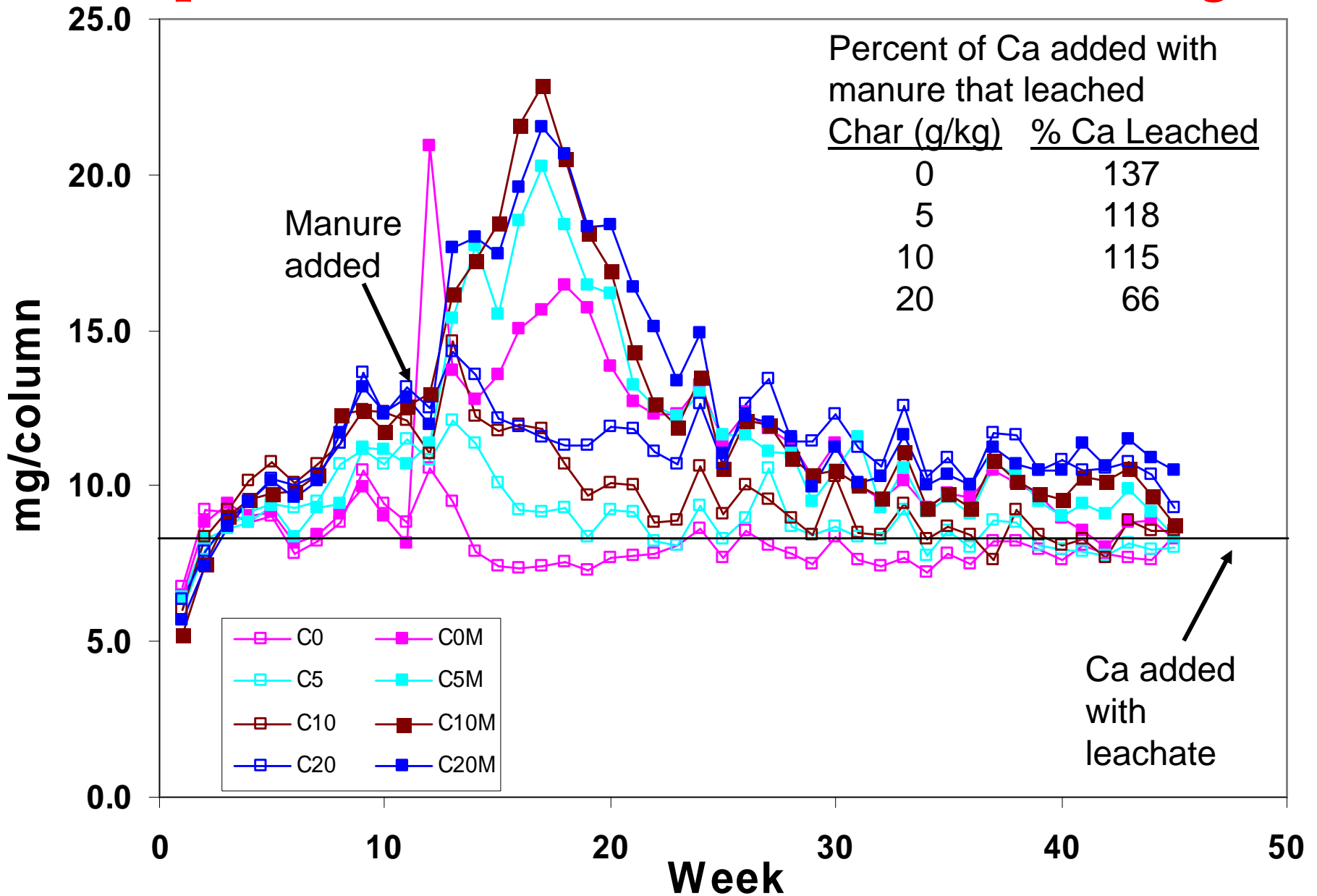


# Impact of biochar and manure on Mg leaching

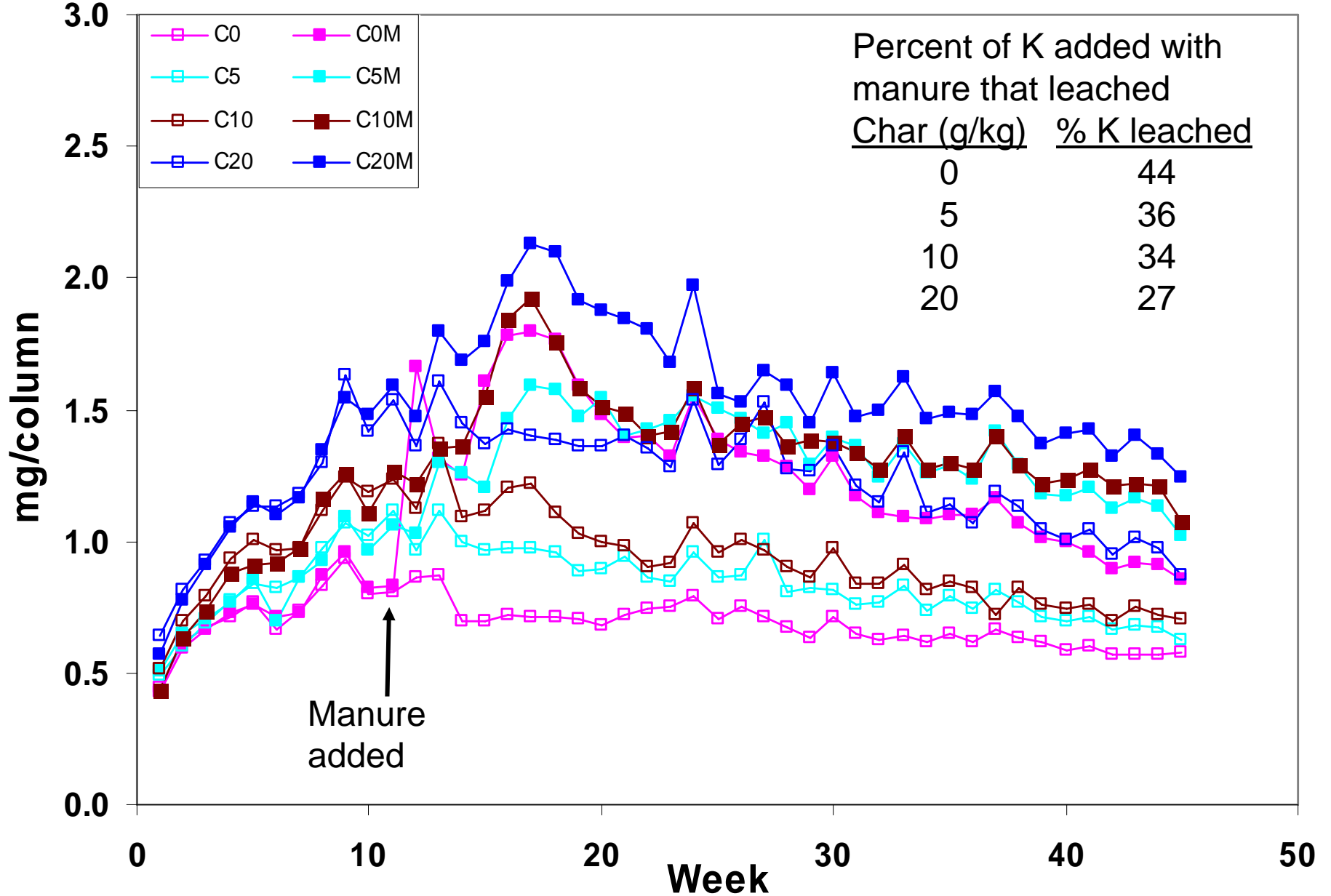




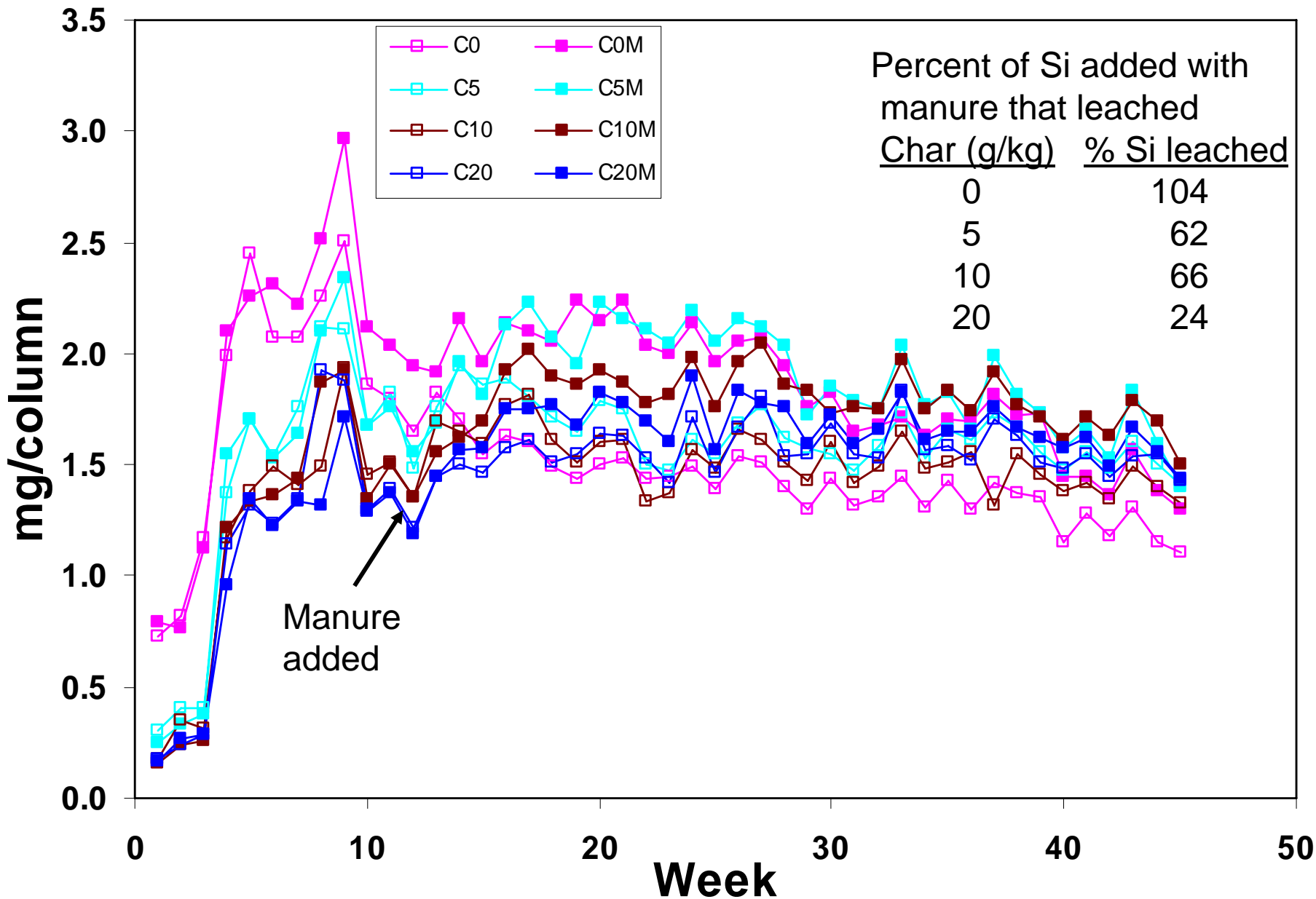
# Impact of biochar and manure on Ca leaching



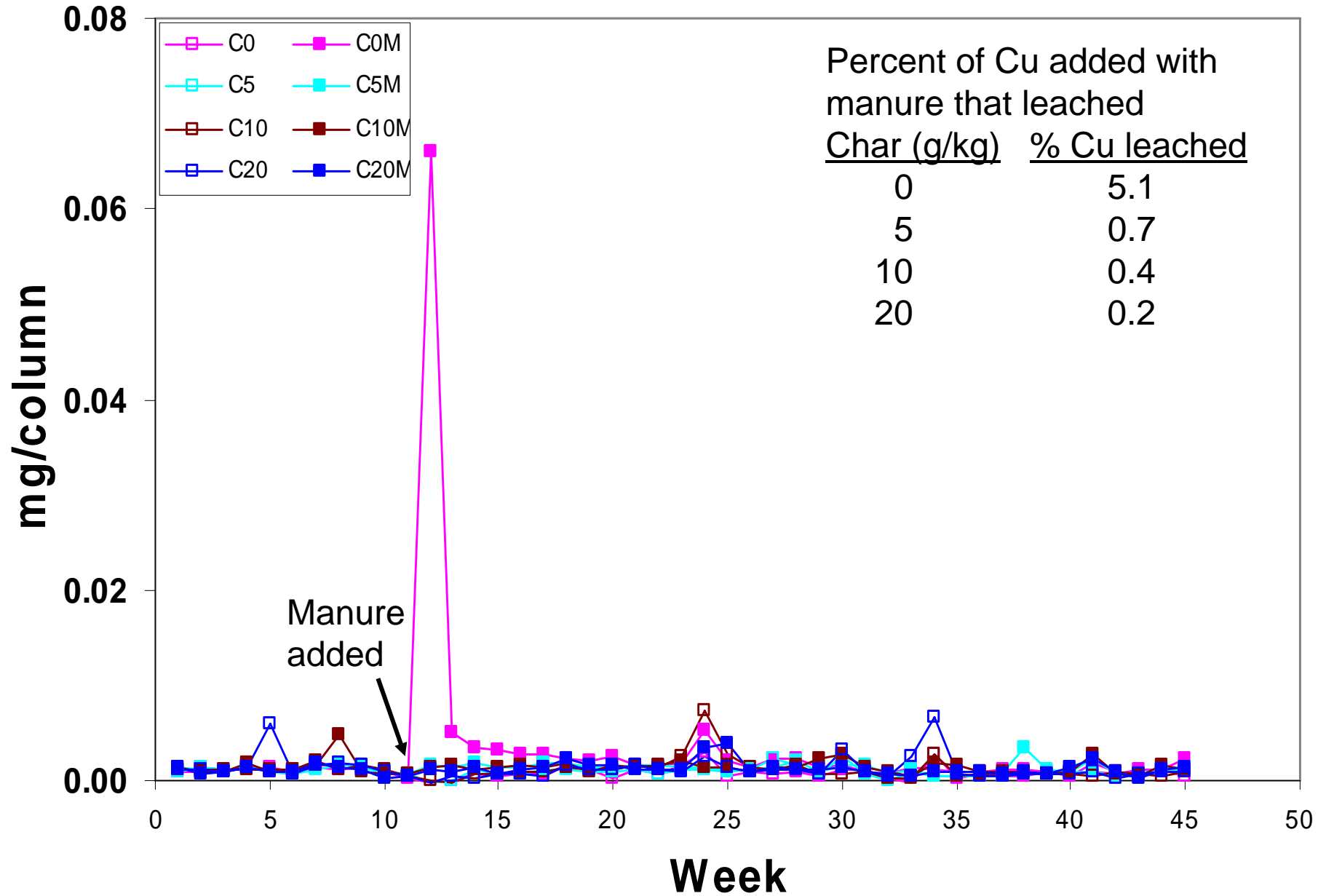
# Impact of biochar and manure on K leaching



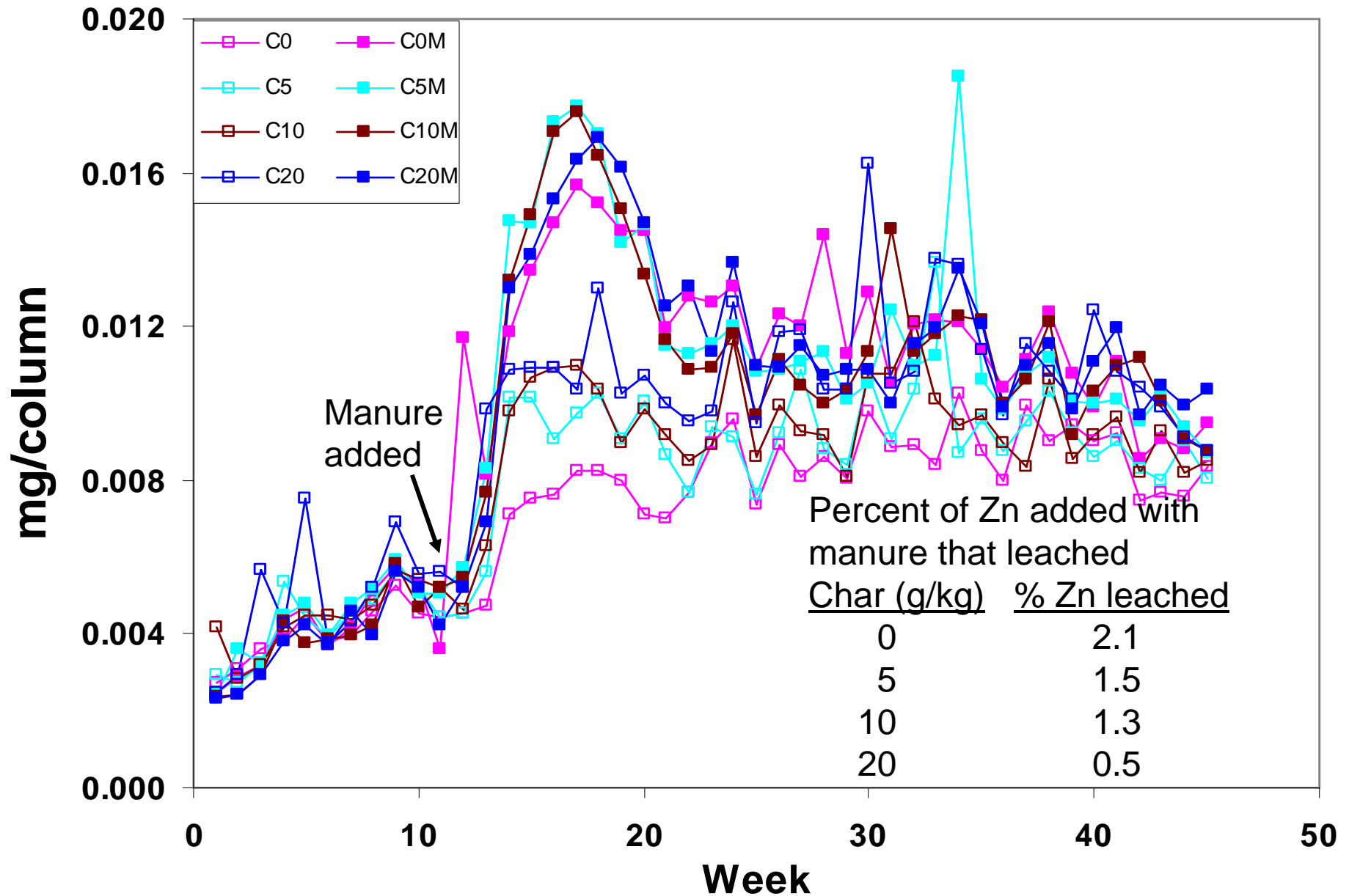
# Impact of biochar and manure on Si leaching



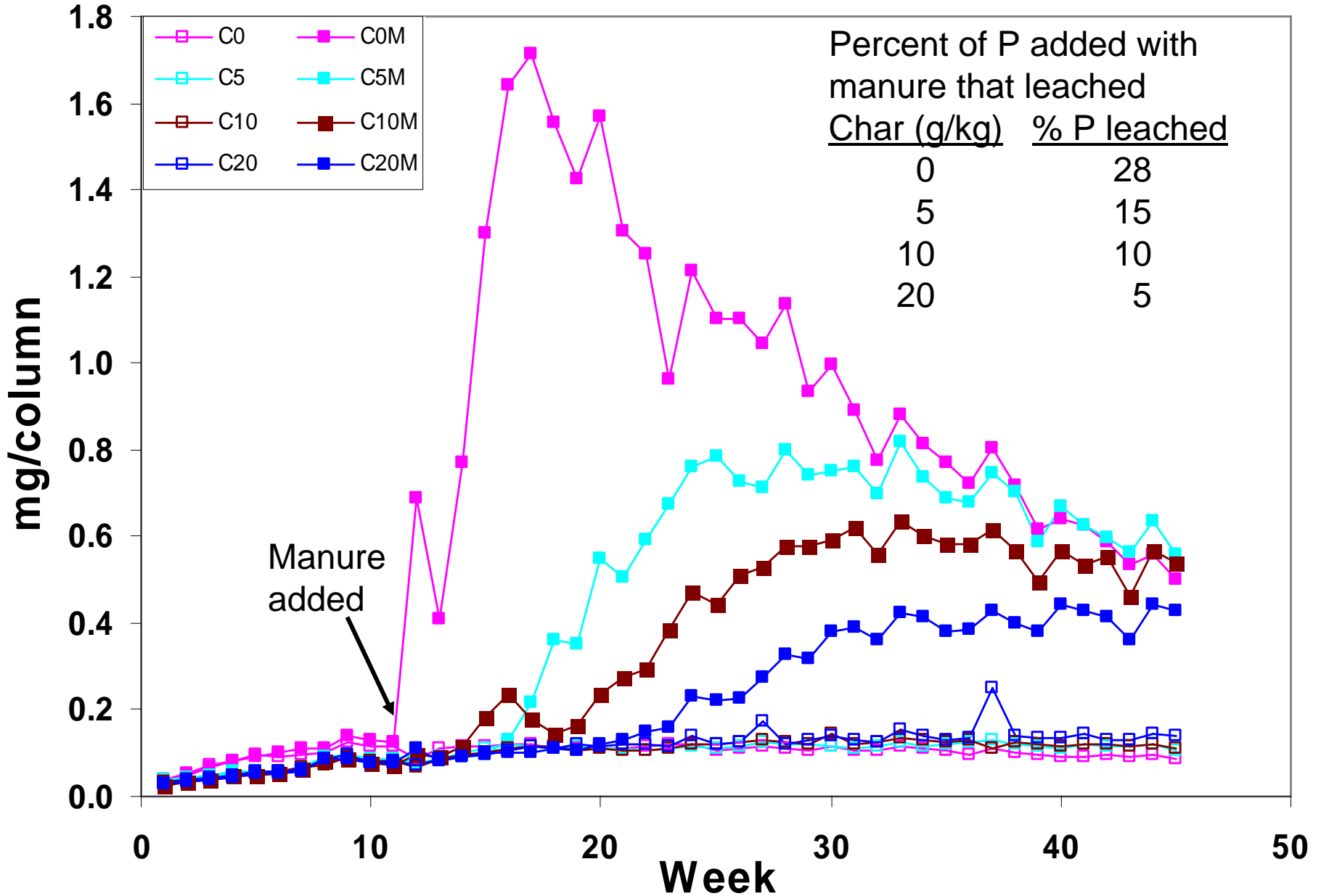
# Impact of biochar and manure on Cu leaching



# Impact of biochar and manure on Zn leaching



# Impact of biochar and manure on P leaching



# Conclusions

## Incorporation of hardwood biochar

- Increased CEC, pH, and total organic N.
- Reduced leaching of  $\text{NO}_3$  by 10% after manure application.
- Increase leaching of  $\text{NO}_3$  by 56% for the no-manure controls.
- Reduced leaching of Na, Ca, Mg, K, Si, Cu, and Zn.
- Biochar additions reduced P leaching by 40 to 70% following a manure application.

**Biochar additions to agricultural soils appears to be an effective means of reducing nutrient leaching following manure applications.**

Thanks to David Meek for help with statistics