EFFECT OF LONG-TERM NITROGEN APPLICATION ON THE TOTAL CANBON IN CALCAREOUS SOIL

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Introduction

A small variation in soil C stores could lead to marked change in the CO2 concentration of atmosphere. it has been has given rise to numerous investigations of SOC because of sensitive to change of land use and manage practices. By contrast, the SIC are often assumed to be relatively stable and the exchange with atmosphere have a minor contribution to the terrestrial C balance with estimated at a rate of 1.0–5.0gC m^{-2} yr^{-1}.However, recent study showed that non-biologic process of carbon absorption could be as high as 62-622g g C m^{-2} yr^{-1}.

Calcareous Alluvial is the main soil type in the North China Plain, which has a high content of carbonate from 6 to 15kg C m^{-2} in the top of soil. It is essential to integrated research the impact of nitrogen fertilizer on the C behavior and balance including both organic and inorganic pattern in this specific agricultural areas.

Experimental site

The experiments were carried out on farmers' fields in the Luancheng Agro-ecological Experimental Station, Chinese Academy of Sciences, in Luancheng County, Hebei Province(37.89° N, 114.67° E). It is located in the North China Plain. The locations characterized by a sub-humid climate with a mean annual temperature of 12.3℃ and a mean annual precipitation of 537mm.

Experiments designed

Field experiments were established in 1998 with randomized complete block N-response plots (10 m × 7 m) with three replicates. The plots were fertilized 4 times per year at four different urea N application rates, i.e. no fertilizer input (N0), 200 kg N ha-1 yr-1 (N200), 400 kg N ha-1 yr-1 (N400), and 600 kg N ha-1 yr-1 (N600).

In 2012, soil cores (0–100 cm deep) were collected using a soil auger (4 cm in diameter) after corn harvest from each plot; these cores were sectioned by depth and divided into sections of 0–20, 20–40, 40–60, 60–80, and 80–100cm deep. Concurrently, one-point soil sample for solutions analysis was collected in 0-12m depth in each nitrogen treatment without replicates. The sample was collected as soil columns (1.2 m long and 43 mm inner diameter) by using Geoprobe (Geoprobe 54DT, USA). Soil organic carbon (SOC) was measured by the $K_2Cr_2O_7$–H_2SO_4 oxidation method of Walkey and Black (Nelson and Sommers, 1982). The concentration of SIC was measured by manometric collection of CO_2 evolved during an HCl treatment process.

Results

Fig.1 The distribution of SIC and SOC in soil profiles

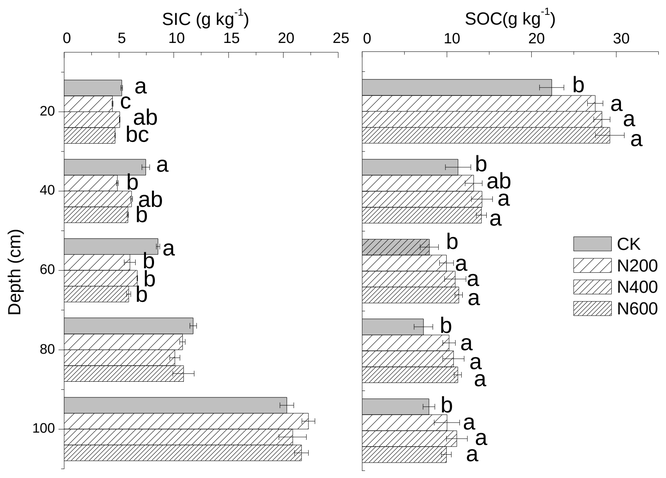
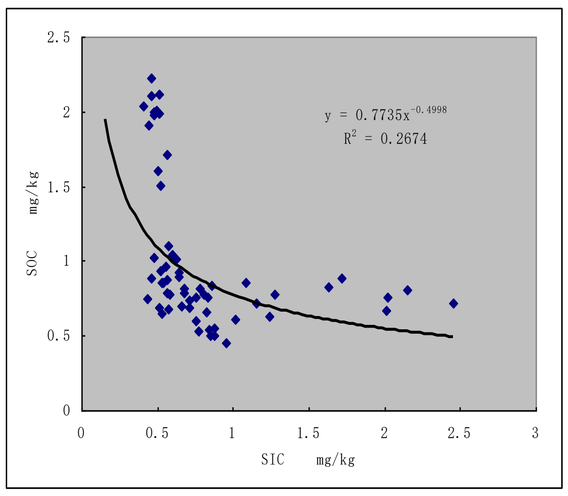


Fig.2 The relationship of SIC and SOC in soil profiles



Tab.1 The storage of total carbon(SIC and SOC) and C gain efficiency after long-term nitrogen

	SIC storage (Mg ha^{-1})		SOC storage (Mg ha^{-1})		TC storage (Mg ha^{-1})		C gain efficiency in 0-60cm (g C g $^{-1}$N added)		
	0-60cm	0-100 cm	0-60cm	0-100 cm	0-60cm	0-100 cm	SIC	SOC	TC
CK	55.4a	138.8	45.2c	61.6c	100.5	200.4	-	-	-
N200	39.7b	125.8	54.9b	76.9b	94.7	202.7	-5.2	5.1	-0.1
N400	45.6b	124.5	58.0a	81.8a	103.6	208.9	-1.7	3.4	1.7
N600	42.6b	127.2	59.3a	82.4a	101.9	209.6	-1.4	2.3	0.9

Fig.3 the content of cations from soil solutions in profiles

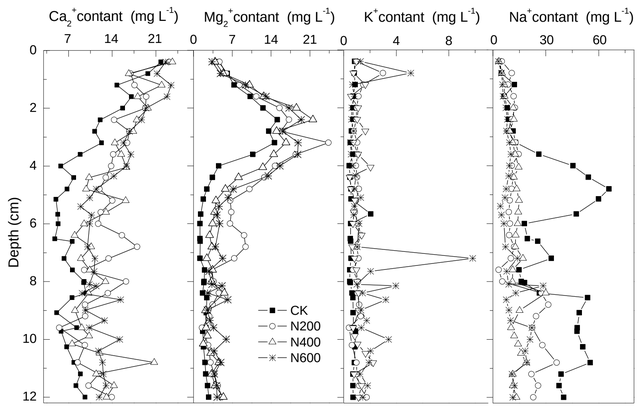
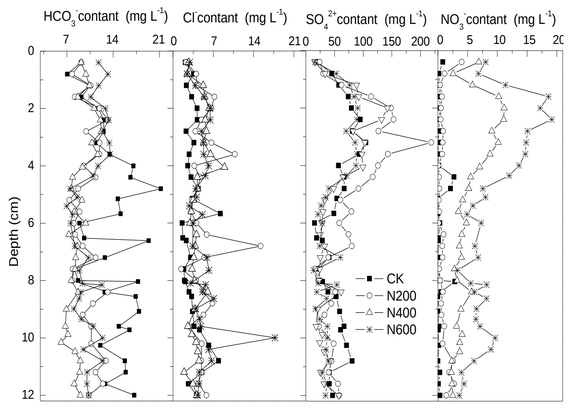


Fig.4 the content of anions from soil solutions in profiles



Conclusion

SIC content for CK was higher significantly than N200 and N600 in 0-60 cm layers, and was higher than N400 except for in 40-60cm. In contrast to SIC, SOC content for CK is lower than these three treatments of applying nitrogen in each individual layer, except for N200 in 20-40 cm layer. The total stock of SOC both in 0-60cm and 0-100cm soil profile was significantly increased with rates of applied nitrogen. the total soil carbon (SIC+SOC) stock did not differ among all the four treatments in the 0-60 cm or the 0–100 cm layer.

Theoretically, 1 kg N ammonium fertilizer can produce 0.19 k mol acid (+) and dissolve 1.7kg C soil carbonate. But, in this study the loss efficiency of SIC (negative C gain efficiency) is higher or equal to this value for the N200 (5.2) and N400 (1.7) treatments, These analyses imply that other processes beside nitrification must also be responsible for the decrease in the carbonate content in the 0-60 cm soil layers. the amount of HCO3- in soil solution were higher for treatments with nitrogen than the CK treatments in 0-80cm layers, suggesting that dissolution of carbonate mainly was driven by carbonic acid from soil. Thus, the total carbon as CO2 sink was underestimated, because Dissolution of carbonate by carbonic acid uptake the atmospheric CO2, but not emission .

Acknowledgements

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