Effects of Gypsum on Amelioration of Subsoil Acidity of Andisols

著者	TOMA M., SAIGUSA M., QAFOKU N., SUMNER M. E.
journal or publication title	Journal of Integrated Field Science
volume	2
page range	69-71
year	2005-03
URL	http://hdl.handle.net/10097/30942

Effects of Gypsum on Amelioration of Subsoil Acidity of Andisols

M. TOMA [1], M. SAIGUSA [2], N. QAFOKU [3], and M.E. SUMNER [4]

[1] Experimental Farm, Faculty of Agriculture, Yamaguchi Univ., Japan
[2] Tohoku Univ, Japan [3] PNNL USDOE; [4] Univ. of Georgia, USA

In acid soils such as nonallophanic Andisols, crop production is severely limited because of the presence of chemical barriers such as subsoil Al toxicity and Ca deficiency. These barriers often restrict the root penetration in these subsoils reducing crop yields. However, surface application of lime ($CaCO_3$) is not effective in amelioration of subsoil acidity because of low solubility and slow movement in soil profile. On the other hand, gypsum ($CaSO_4 \cdot 2H_2O$), which has higher solubility, is used as a practical ameliorant for subsoil acidity (Shainberg et al. 1989). In this presentation, the authors summarize the effects of gypsum on amelioration of subsoil acidity of Andisols.

Experiment 1 : The movement of gypsum and the effects on subsoil acidity were evaluated using open end columns 0.45 m long with interior diameter of 0.10m (Saigusa et al. 1996, Toma and Saigusa 1997). According to humus content, two types of Andisols (Andosols) were used as test soils (Table 1). Gypsum were mixed in top 0.15m and 300mm of water were applied. Ca applied as gypsum moved down to both subsoils (Fig. 1), however reduction of exchangeable acidity (y_1) (Fig. 2) and deep root penetrations into subsoils (Fig. 3) were observed only in the low humus soil. These results suggested that gypsum is effective to the soils with low humus content or soils with relatively shallow high humus topsoil.

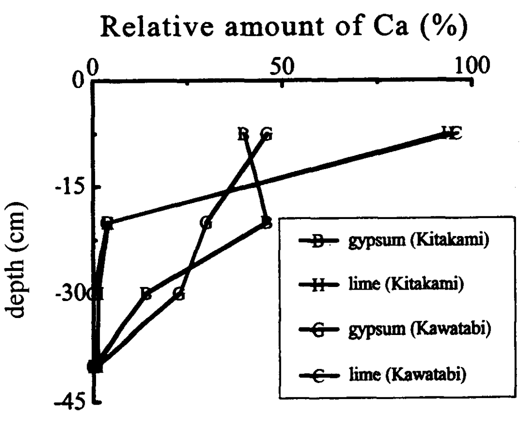

Fig.1. Move of Ca applied as gypsum or lime

Experiment 2 : The long term effects of gypsum were evaluated by field experiment using an Ultisol (Toma et al. 1999). The experiment was conducted in Plant Science Farm of The University of Georgia, Oconee County, GA, U.S.A. Gypsum was surface-applied and mixed to a depth of 0.15m. Even 16 years after application, the effects of gypsum were still clearly visible. Exchangeable Ca was higher down the soil profile in the gypsum treatment (Fig. 4). The reduction in exchangeable Al was observed in gypsum treatment to 80 cm depth (Fig. 5). This amelioration of the effects of subsoil acidity was

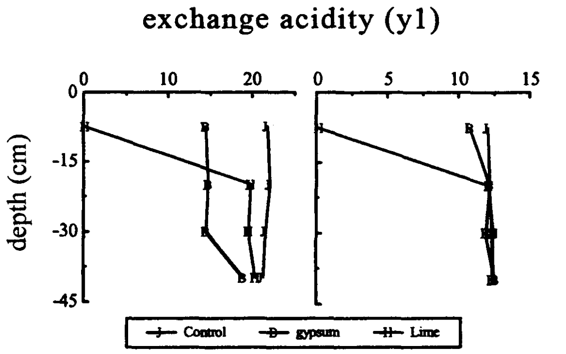

Fig. 2. Profile distribution pattern of exchange acidity (y1)

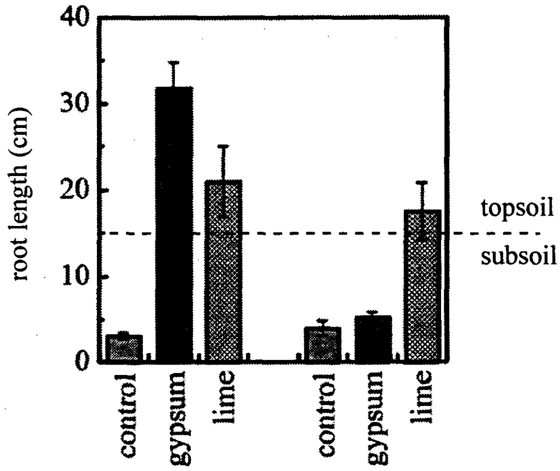

Fig. 3. Effect of gypsum on root elongation of barley

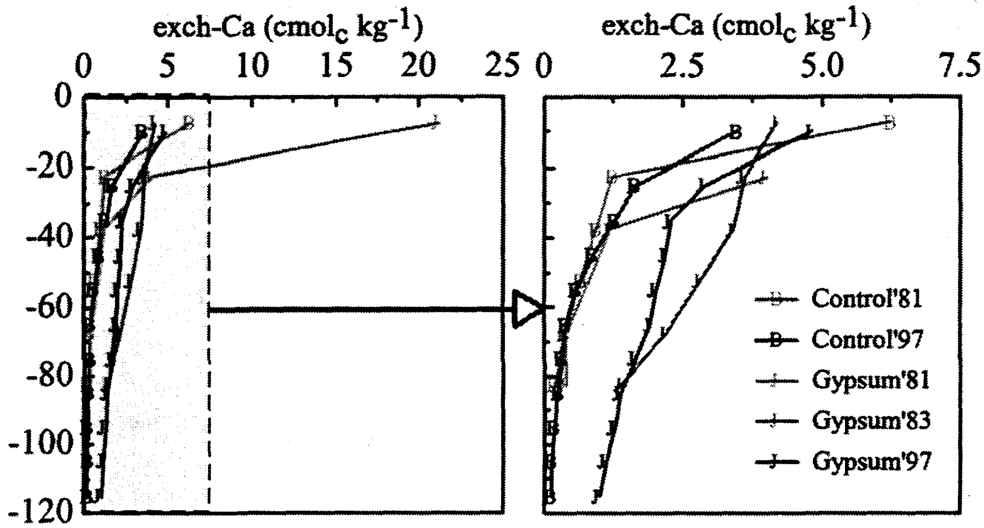

Fig. 4. Change of Exchangeable Ca status with time after gypsum application

Table1. Some properties of test soils for experiment 1

	pH(H_2O)	pH(KCl)	y1	Organic−C	Classification
Kitakami(low humus)	5.4	4.2	19.4	0.59	Fine, mixed, mesic, Andic Dystrochrept
Kawatabi(high humus)	4.9	4.2	11.8	14.52	Medial, Alic Pachic Melanudand

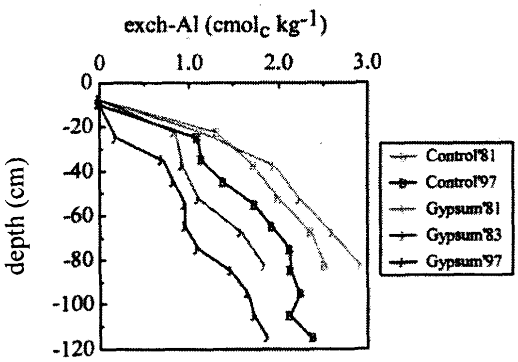

Fig. 5 Changes of exchangeable Al status with time after gypsum application.

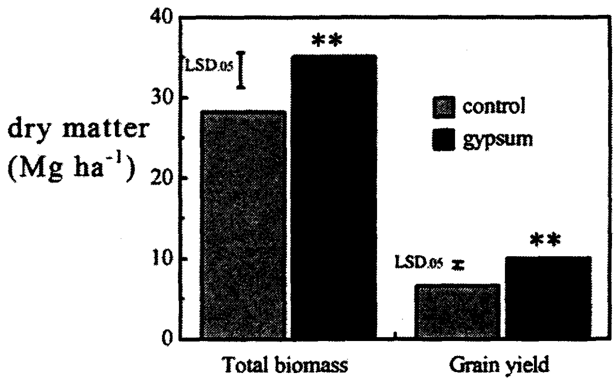

Fig.6 Effect of gypsum applications made 16 years previously on corn yield

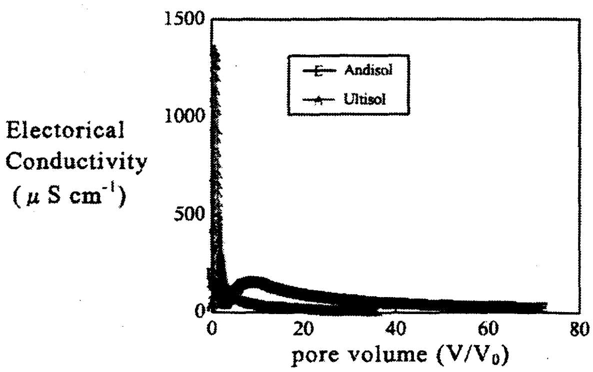

Fig. 7 Electorical conductivity breakthrough curves of leachates

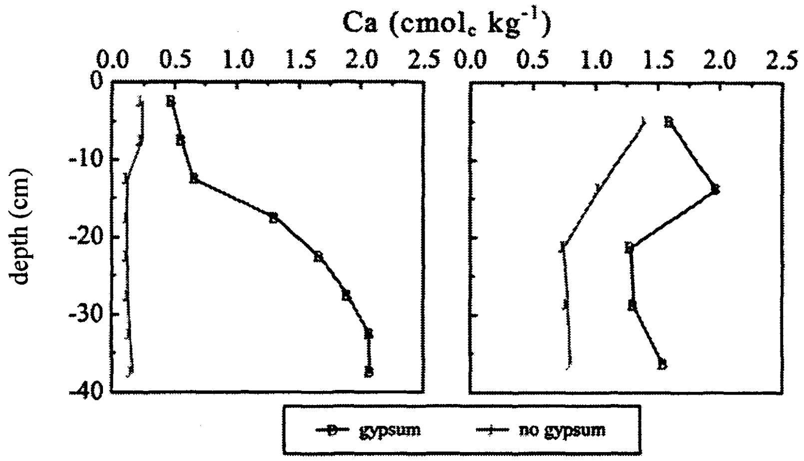

Fig. 8 Distribution of calcium in soil columns at the end of leaching experiment

reflected in improvement of crop yields (Fig. 6).

Experiment 3 : Column experiments were conducted in order to understand better the fate and transport of gypsum in acid soils and to estimate the long term effects of gypsum on subsoil chemical properties. An Andisol from Iwate, Japan and an Ultisol from Georgia, U.S.A. were used as test soils. The columns used were 0.4 m long with an interior diameter of 0.05 m. Gypsum was mixed in top 0.1m and leached with deionized water using a peristaltic pump at a flow rate of 1 mL min^{-1}. About 72 and 36 pore volume of water were leached to reduce the electrical conductivity of effluent below 20 μ S cm^{-1} in Andisol and Ultisol, respectively (Fig. 7). These amounts of water were equal to 22 and 9 years of precipitation. Gypsum applied in the topsoil significantly increased the amount of exchangeable Ca in the subsoil (Fig8) . These results sggested that effects of gypsum appeared to continue for many years.

References

Saigusa, M., M. Toma, and M. Nanzyo. 1996. Alleviation of subsoil acidity in nonallophanic Andosols by phosphogypsum application in topsoil. Soil Sci. Plant Nutri. 42 : 221-227.

Shainberg I. , M. E. Sumner, W. P. Miller, M. P. Farina, M. A. Pavan and M. V. Fey 1989. Use of gypsum on soils : A review. Adv. Soil Sci. 9 : 1-111.

Toma, M. and M. Saigusa. 1997. Effects of phosphogypsum on amelioration of strongly acid nonallophanic Andosols, Plant and Soil 192 : 49-55.

Toma, M. M.E. Sumner, G. Weeks, and M. Saigusa. 1999. Long-term effects of gypsum on crop yield and subsoil chemical properties. Soil Sci. Soc. Am. J. 39 : 891-895.