Scientific registration n°: 1775
Symposium n°: 40
Presentation: poster

Radiological Impact of Applying Phosphogypsum to Soil
Under a Bahiagrass Pasture
Impact radiologique de l’apport de phosphogypse

RECHCIGL Jack (1), ALCORDO Isabelo (1), ROESSLER Charles (2), LITTELL Ramon (3)

(1) University of Florida (UF), Institute of Food and Agricultural Sciences (IFAS), Range Cattle Research and Education Center, Ona, FL, USA
(2) UF, College of Engineering, Dept. of Environmental Engineering, Gainesville, Fl
(3) UF, IFAS, Dept. of Statistics, Gainesville, FL, USA

The production of phosphoric acid by acidulation of rock phosphate with sulfuric acid produces phosphogypsum (PG) as a by-product. Phosphogypsum is primarily CaSO$_4$.2H$_2$O and is a potential source of S and Ca for crops. However, PG contains small amounts of radioactive impurities which raise some environmental concerns. The objective of the study was to evaluate the radiological impact of applying phosphogypsum to a Myakka soil (sandy, siliceous, hyperthermic Aeric Haplaquods) cropped to bahiagrass (Paspalum notatum Flugge). The PG with 792 $^{226}$Ra, 836 $^{210}$Pb, and 744 $^{210}$Po Bq kg$^{-1}$ was applied once at 2 and 4 Mg ha$^{-1}$ (with no PG as control) to plots whose top 15-cm soil layer contained 20.3, 22.6, and 19.6 Bq kg$^{-1}$ of $^{226}$Ra, $^{210}$Pb, and $^{210}$Po, respectively. The 4 Mg ha$^{-1}$ rate would have increased initial soil $^{226}$Ra, $^{210}$Pb, and $^{210}$Po by 7% each in the top 15-cm layer. Averaged over a 3-yr period, no increases in $^{226}$Ra, $^{210}$Pb, or $^{210}$Po beyond normal variability were noted in soil down to 90 cm sampled in layers of 15 cm. An increase in $^{210}$Pb in groundwater at 90-120 cm depth was noted. In regrowth and in mature forage, 3-yr mean $^{226}$Ra increased by 0.48 and 0.55 Bq kg$^{-1}$ per Mg PG ha$^{-1}$, respectively. Total concentrations, however, were within the range in various forages grown on untreated soils reported in the literature. There were no measurable effects of PG on $^{210}$Pb or $^{210}$Po in forages, on $^{222}$Rn flux measured at the surface of the plots, and on gamma radiation and airborne $^{222}$Rn both measured 1 m above the plots. Thus, PG containing about 800 Bq $^{226}$Ra kg$^{-1}$ can be applied at agronomic rates to enhance bahiagrass forage yields for cumulative applications up to 4 Mg ha$^{-1}$ with little or no effect on the various radiological measures in soil, groundwater, plant tissue, or on the ambient atmosphere. Over a 100-yr period, annual rates of 0.65 Mg ha$^{-1}$ (normal rate for gypsum as S or Ca source for crops) of PG used in the study would have increased $^{226}$Ra by 5.14 x 10$^7$ Bq ha$^{-1}$. The EPA-suggested rate limit of 3.024 Mg ha$^{-1}$ (2,700 lbs ac$^{-1}$) applied biennially for PG with 370 Bq $^{226}$Ra kg$^{-1}$ (10 pCi g$^{-1}$) would have increased $^{226}$Ra by 5.59 x 10$^7$ Bq ha$^{-1}$ over the same period.

Keywords: phosphogypsum, radionuclides, radon, airborne radon, bahiagrass
Mots clés : phosphogypse, radionucléide, radon, radon atmosphérique