Supplemental Material

Effect of co-granulation on oxidation of elemental sulfur: theoretical model and experimental validation

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**Fig. S1.** Optical images of the elemental S (ES) particles extracted from the fertilizer granules with the small (A) or larger ES particles (B). The middle panels show the distribution derived from the optical images (three replicate slides) and the lower panels show the predicted oxidation in a soil with surface-based oxidation rate ($k$) of 62 µg cm$^{-2}$ d$^{-1}$ for particles with this distribution (as estimated by dividing in ten size-classes and adding up the contribution of each size-class; Watkinson, 1993) or for single-sized particles with a diameter of 25 or 60 µm.
Fig. S2. (A) Leaching of S (left) and (B) % of S applied as ES recovered in the leachate, for the treatments without ES fertilizer (control, MAP only) or with 10 mg ES particles of different size mixed throughout the soil (diameter as specified in the legend). Error bars are standard errors of three replicates. The lines in panel (A) are for visual aid. The lines in panel (B) give the modelled oxidation curves for a surface-based oxidation rate constant of 61 µg cm$^{-2}$ d$^{-1}$. 
Fig. S3. Cumulative recoveries of ES-derived S in the leachates and %ES remaining in soil as a function of time for treatments with different granule and ES particle size (indicated at left) and different ES content (indicated at top). The symbols give measured values (open: leached S, closed: ES), the black lines the fitted oxidation curves (full: leached S, dashed: ES) and the blue lines the predicted oxidation curves (using $d_{eff}$ calculated from the fertilizer composition).
Fig. S4. Effect of granule size on oxidation rate as observed for MES10 granules (MAP-based granules with 50 g ES kg\(^{-1}\)) in Edmonton soil (Degryse et al., 2016). Cumulative recoveries of ES-derived S in the leachates (black) and %ES remaining in soil (orange) as a function of time for granules with an average diameter of (A) 1.7 mm or (B) 3.4 mm. The symbols give measured values and the lines the fitted values (\(d_{\text{eff}} = 126 \, \mu\text{m (A) or 246 } \mu\text{m (B); parameters for immobilization: } I_{\text{max}} = 0.04 \, \text{mg kg}^{-1} \, \text{d}^{-1} \text{ and } K_m = 0.50 \, \text{mg kg}^{-1}).\)