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Incorporation of digestate selectively affects physical, chemical and biochemical properties along with CO_2 emissions in two contrasting agricultural soils in the Mediterranean area.

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Soil incorporation of digestate represents a common practice to dispose the solid residues from biogas producing plants. Although the digestate constitutes a residual biomass rich in partially decomposed organic matter and nutrients, whose content is often highly variable and unbalanced, its potential fertilizer value can vary considerably depending on the recipient soil properties. The aim of the work was to assess short-term changes in the fertility status of two contrasting agricultural soils in Southern Italy (Calabria), olive grove on a clay acid soil (Typic Hapludalfs) and citrus grove on a sandy loam slightly calcareous soil (Typic Xerofluvents), respectively located along the Tyrrhenian or the Ionian coast. An amount of 30 t ha-1 digestate was incorporated into the soil by ploughing. Unamended tilled soil was used as control. The following soil physical, chemical and biochemical variables were monitored during the experimental period: aggregate stability, pH, electrical conductivity, organic C, total N, Olsen-P, N-NH4+, N-NO_3-, microbial biomass carbon (MBC), microbial biomass nitrogen (MBN) and the mineralization quotient (qM). Moreover, in the olive grove soil CO_2 emissions have been continuously measured at field scale for 5 months after digestate incorporation. Digestate application in both site exerted a significant positive effect on soil aggregate stability with a greater increase in clay than in sandy loam soil. Over the experimental period, digestate considerably affected the nutrient availability, namely Olsen-P, N-NH4+, N-NO_3-, along with the electrical conductivity. The soil type increased significantly the soil N-NH4+ content, which was always higher in the olive than in citrus grove soil. N-NO_3- content was markedly increased soon after the organic amendment, followed by a seasonal decline more evident in the sandy loam soil. Moreover, soil properties as $CaCO_3$ content and the pH selectively affected the Olsen-P dynamics. No appreciable variation was recorded in total C and N pools. Interestingly, amendment with digestate altered the soil microbial community size in both soils as MBC and MBN were increased, although the response was more evident in the clay soil (olive) than in the sandy loam (citrus) one. The considerably higher qM observed in the clay soil suggests that the C mineralization was selectively stimulated in this soil. This finding was confirmed by the increase of CO_2 emissions. As a whole our results show that digestate application selectively stimulated soil C dynamics and determined an unbalanced nutrient release, strongly depending on the soil physical-chemical properties. The use of digestate can therefore represent an interesting strategy for managing the soil fertility in Mediterranean agroecosystem soils, provided that digestate and recipient soil properties are carefully taken into account.