

ソルガムの生物的硝化抑制にはアンモニア酸化古細菌の抑制が関連する

Biological nitrification inhibition of sorghum is related to the inhibition of ammonia-oxidizing archaea

硝化抑制物質であるソルゴレオンの土壌中での硝化抑制作用のメカニズムを明らかにするため、根からのソルゴレオン分泌量が異なるソルガム3系統を縦長パイプで栽培した試験を行った(図1)。その結果、ソルゴレオンは生育とともに下層土に向かって新生される根から分泌され、IS20205系統で多かった(図2)。ソルゴレオンの分泌量が多い系統ほど、根圏土壌の硝化活性とアンモニア酸化古細菌数がともに低下するが、アンモニア酸化細菌数は変化が見られなかった(図3と図4)。このことから、ソルガムの生物的硝化抑制にはアンモニア酸化古細菌数の抑制が関連している。

Sorgoleone is secreted from sorghum roots and confers the plant its BNI ability. Through this pipe cultivation test (Fig. 1), we found that 296B shows the least secretion of sorgoleone, followed by IS32234 then IS20205 (Fig. 2). The secreted amount increases towards deeper soil layers at the newer roots zone. The application of nitrogen solution (120 kg ha⁻¹) greatly enhances the nitrification activity but only in the 0-10 cm soil layer (Fig. 3). The nitrification activity opposes with the sorgoleone secretion and is in the order 296B>IS32234>IS20205. The number of ammonia-oxidizing archaea (AOA), but not bacteria (AOB), inversely relates to the amount of sorgoleone and is proportional to the nitrification activity (Fig. 4). This shows the importance of controlling AOA abundance to reduce nitrification activity during sorghum cultivation.

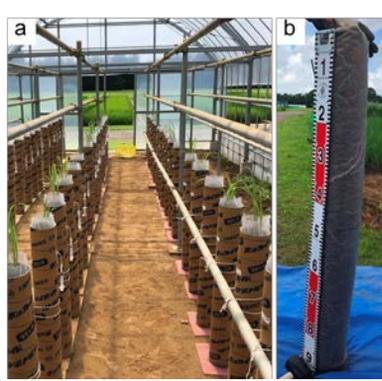


図1 ビニールハウス内でのソルガムのパイプ栽培試験 播種後31日目の状況(a)とパイプを外した土壌柱(b)

Fig. 1. Sorghum pipe (12 cm x 1 m) cultivation test in greenhouse at 31 days after seeding (a), and soil column removed from pipe at the first soil and plant root sampling (b)

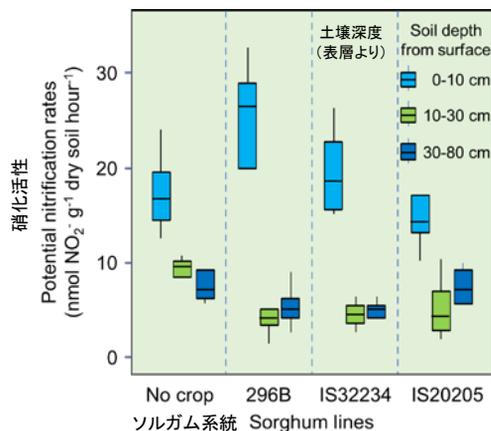


図3 窒素肥料施用下で播種後70日間栽培したソルガム根圏土壌の深度ごとの硝化活性

Fig. 3. Nitrification activity in bulk (no crop) and sorghum rhizosphere soils along the soil profile at 70 days after seeding, under nitrogen fertilizer application (120 kg ha⁻¹)

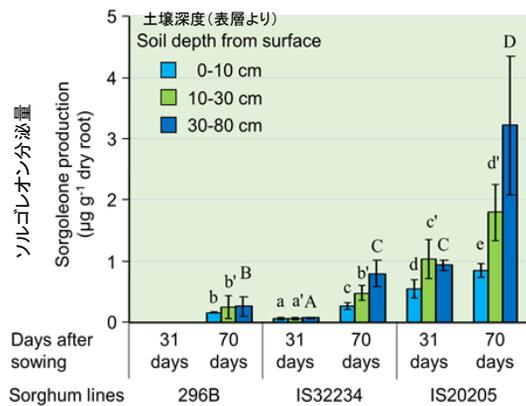


図2 窒素肥料施用下で栽培したソルガムの根からの土壌深度ごとのソルゴレオン分泌量

Fig. 2. Dynamics of sorgoleone secretion from roots of sorghum along the soil profile under nitrogen fertilizer application (120 kg ha⁻¹)

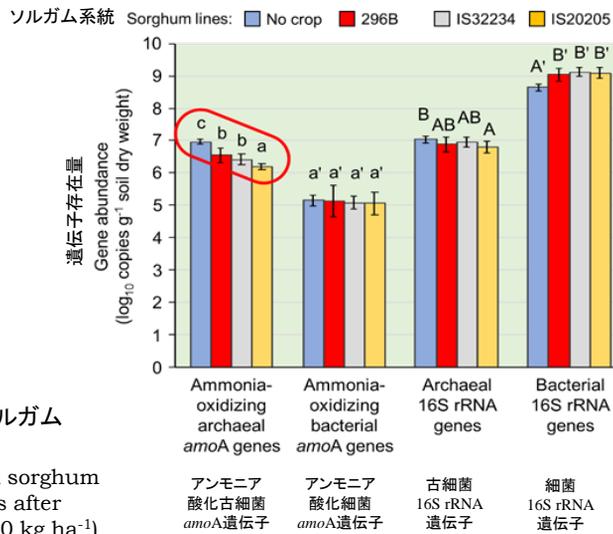


図4 窒素肥料施用下で播種後70日間栽培したソルガム根圏土壌(深度0~10 cm)中の各菌の遺伝子存在量

Fig. 4. Gene abundance in bulk (no crop) and rhizosphere soils (0-10 cm layer) of sorghum lines cultivated for 70 days under nitrogen fertilizer application (120 kg ha⁻¹)