Impact of lime, herbicides and crop rotation on the bacterial community composition and function

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Herbicides and lime are widely used in low pH agricultural soils in south-western Australia. Short-term impacts of various herbicides on soil microbial communities have been reported. However, off-target effects of herbicides on soil microbial communities with potential to negatively affect soil functions are well not known. Therefore, we investigated changes in bacterial community composition following herbicide and lime application for a wheat-wheat-lupin-barley-barley crop rotation to control annual ryegrass at Merredin, Western Australia. Lime and herbicide treatments were established in plots 2m x 20m with lime in the main plots and herbicides in the sub-plots, with four replicates. Four rates of lime were applied on the soil surface in 2010. In the sub-plots, five rates of Sakura® (pyroxasulfone 850 g ai/kg) were applied before sowing wheat in 2010 and 2011. In 2012, simazine (500 g ai/L) was applied at 2 L/ha at sowing and Brodal® (diflufenican 500 g ai/L) plus metribuzin at 4-5-leaf stage of lupins across all the plots. For barley in 2013, five rates of Boxer Gold® (prosulfocarb + s-metolachlor) were applied 1-2 days before sowing crop. In 2014, soil was treated with five rates of TriflurX 480 (trifluralin 480 g ai/L) immediately before sowing barley. In 2015, soil was sampled from 0-10 cm at multiple points in each plot and bulked into a composite sample (80 soil samples for the experiment). Bacterial community composition in response to herbicide and lime treatments was compared with the untreated plots using 16S rRNA gene sequencing with the Ion Torrent platform. After five years of continuous herbicides application, annual ryegrass population was controlled and a substantial increase in crop yield has occurred. Use of herbicides in crop rotation in combination with lime has resulted in an altered soil community composition but the extent to which this was associated with changes in soil properties such as change in soil pH is being investigated.