

Evolution of Ryegrass Resistance to Glyphosate Changes Soil Microbial Diversity 14 Years of Continuous Application

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Glyphosate is the most widely used herbicides in agriculture. Short-term impacts of glyphosate on soil microbial communities have been reported but long-term effects are rarely studied. There is concern for non-target effects on soil microbial communities with potential to negatively affect soil functions after long-term use of glyphosate. Therefore, our objective was to investigate changes in bacterial community composition following long-term glyphosate application on annual ryegrass. Four treatments (1. Glyphosate 92 g/ha as spray topping at anthesis; 2. Glyphosate 360 g/ha as spray topping at anthesis; 3. Glyphosate 230 g/ha at 3-4-leaf stage; and 4. Glyphosate 920g/ha at 3-4-leaf stage) plus untreated control areas were established by DPIRD in 1999 on annual ryegrass population at the Merredin Research Station, Western Australia. The initial density of annual ryegrass was 400 plants/m². Other weeds were present at very low density in 1999. Each treatment was established on a 1-ha block of clay loam soil with a 2 m buffer around each plot. The paddock was fenced but not grazed and has been managed as a volunteer pasture site since 1999. One application of glyphosate as per treatment mentioned above was applied annually since 1999. Soil was sampled from 8 grids @ 4 samples per grid equal to 32 points (0-10cm) from each treatment and combined to make 8 bulk samples for each treatment. Bacterial community composition was compared between glyphosate treated and untreated soil using 16S rRNA gene sequencing with the Ion Torrent platform. After 14 years of continuous glyphosate application, herbicide resistance was confirmed in annual ryegrass and red brome population. A substantial shift in weed species has occurred during this period. Long-term use of glyphosate resulted in an altered soil community composition but the extent to which this was associated with changes in soil properties such as cation exchange capacity or change in plant species composition is reported here.