

Microplastics in Irish soil: A cause for concern?

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Background

Microplastics (MP) have been studied at length in aqueous environments but very little work has been conducted on their prevalence and concentrations in soils. MP contaminated soil may very well reduce crop yields and have a direct impact on human health. MP have been linked to human disease as well as severely impacting ecosystems and disrupting food chains.(1-3)

This project is a small pilot study to develop a method for MP extraction from soil and to test samples of Irish soil for a base line MP concentration. Both farm soil and Garden soil were investigated.

Results

Two investigations were carried out, one with agricultural soil and one with garden soil.

Agricultural soils



Figure 2: LDPE on farm

Low density polyethylene used in wrapping silage is present on nearly every farm, piles like on the right are common place and particles are bound to enter the soil.

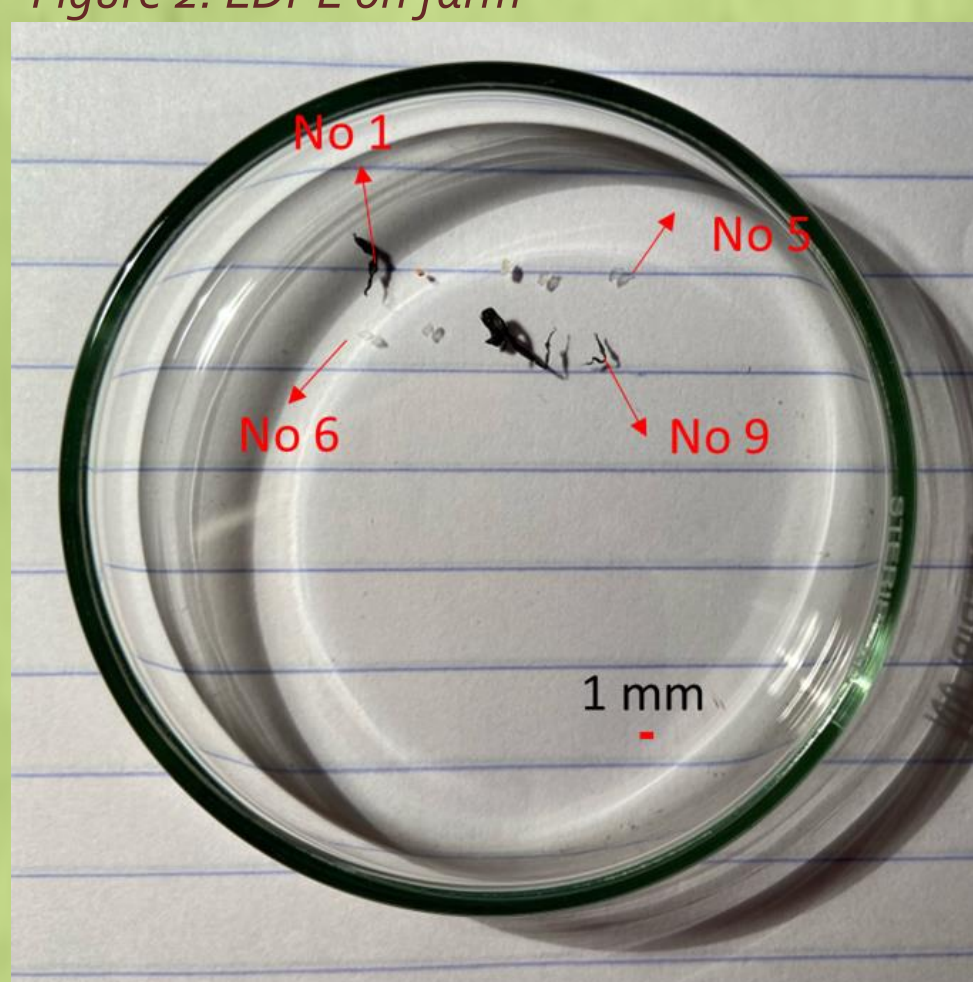


Figure 3: MP particles extracted from farm soil

MP particles which were isolated from 50g of farm soil. These particles were separated from the soil by using a solution of zinc chloride. The separation stage of the extraction method proved to be the most complicated as each different plastic has a different density.

Methodology

The first challenge was to develop a standardised system of removing MP from the soil. The soil was dried and sieved, then the MP was separated by density from the other soil particles. Digestion then took place by removing any organic matter. Finally, Raman spectroscopy will be used to identify MP particles.

Digestion was a very important part of the method as any organic matter would hamper the spectroscopy readings. Digestion was carried out using Fenton's reagent, a 2:1 mixture of Hydrogen peroxide and Iron sulphate.

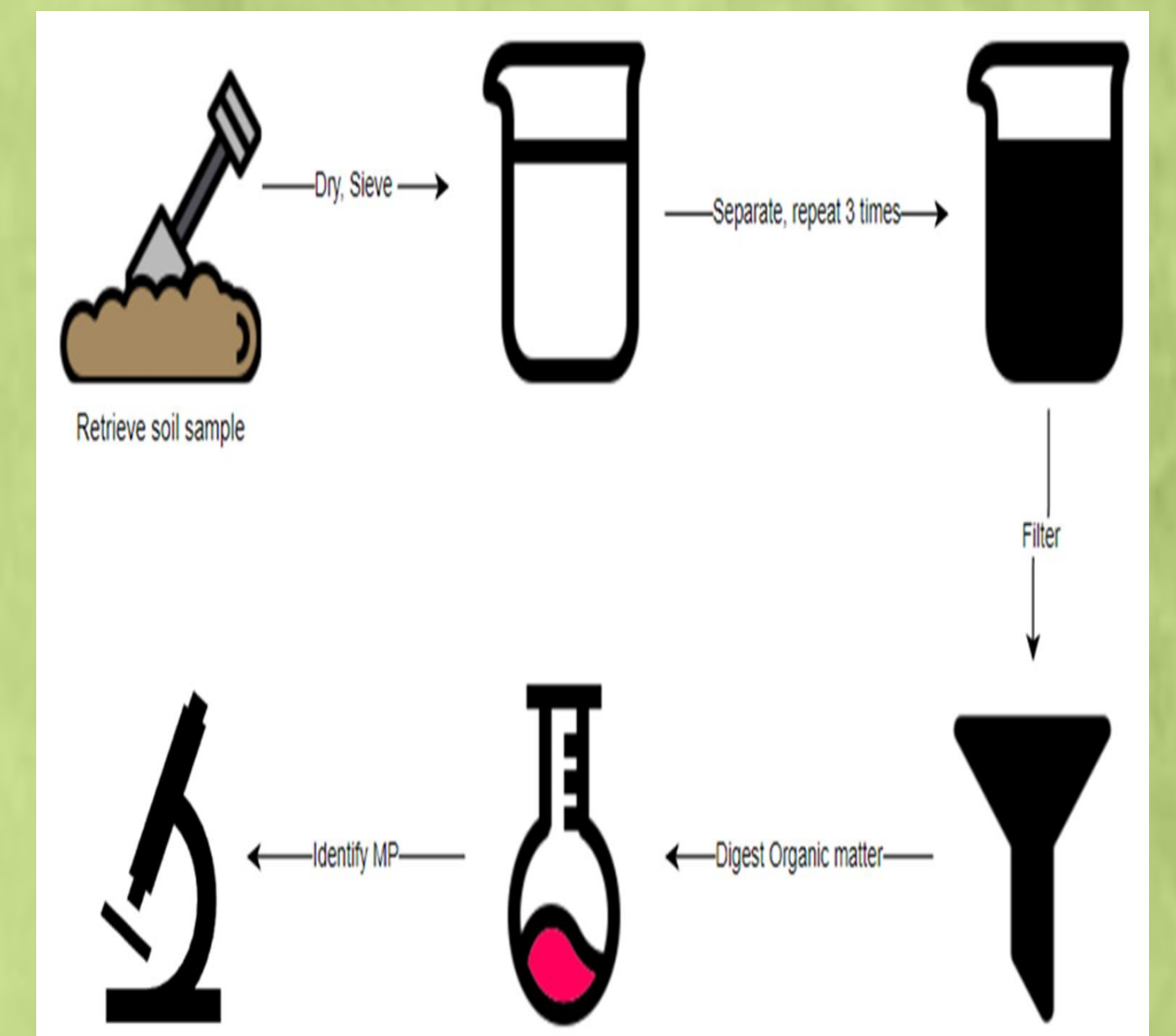


Figure 1: flow diagram of extraction method

Garden soils

Garden soils are much different to agricultural soils, humans interact with them differently and their composition can vary hugely. The garden soils in this investigation were from counties Carlow and Dublin and were all brown earths. 15 samples from 5 different gardens were taken, the 3 samples, each 100g from each site were combined and divided into 6 50g testing samples.



Figure 6: Example of plastic in soil, circled

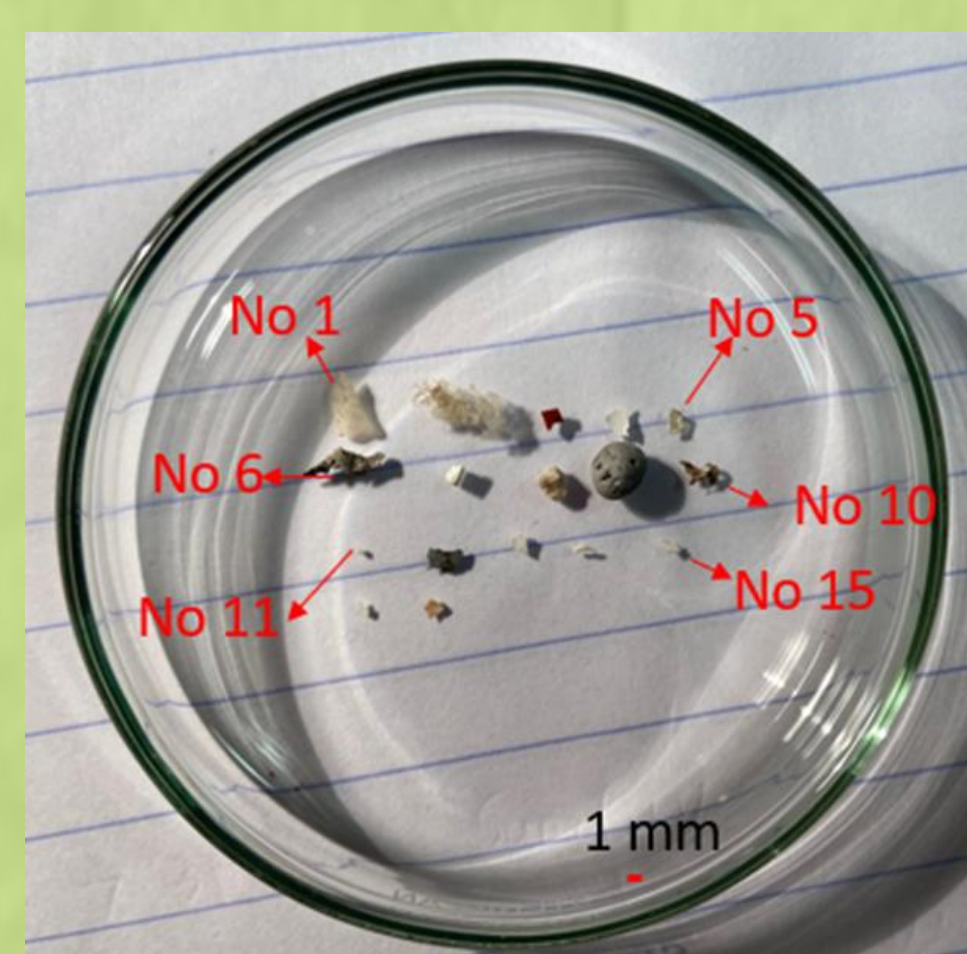


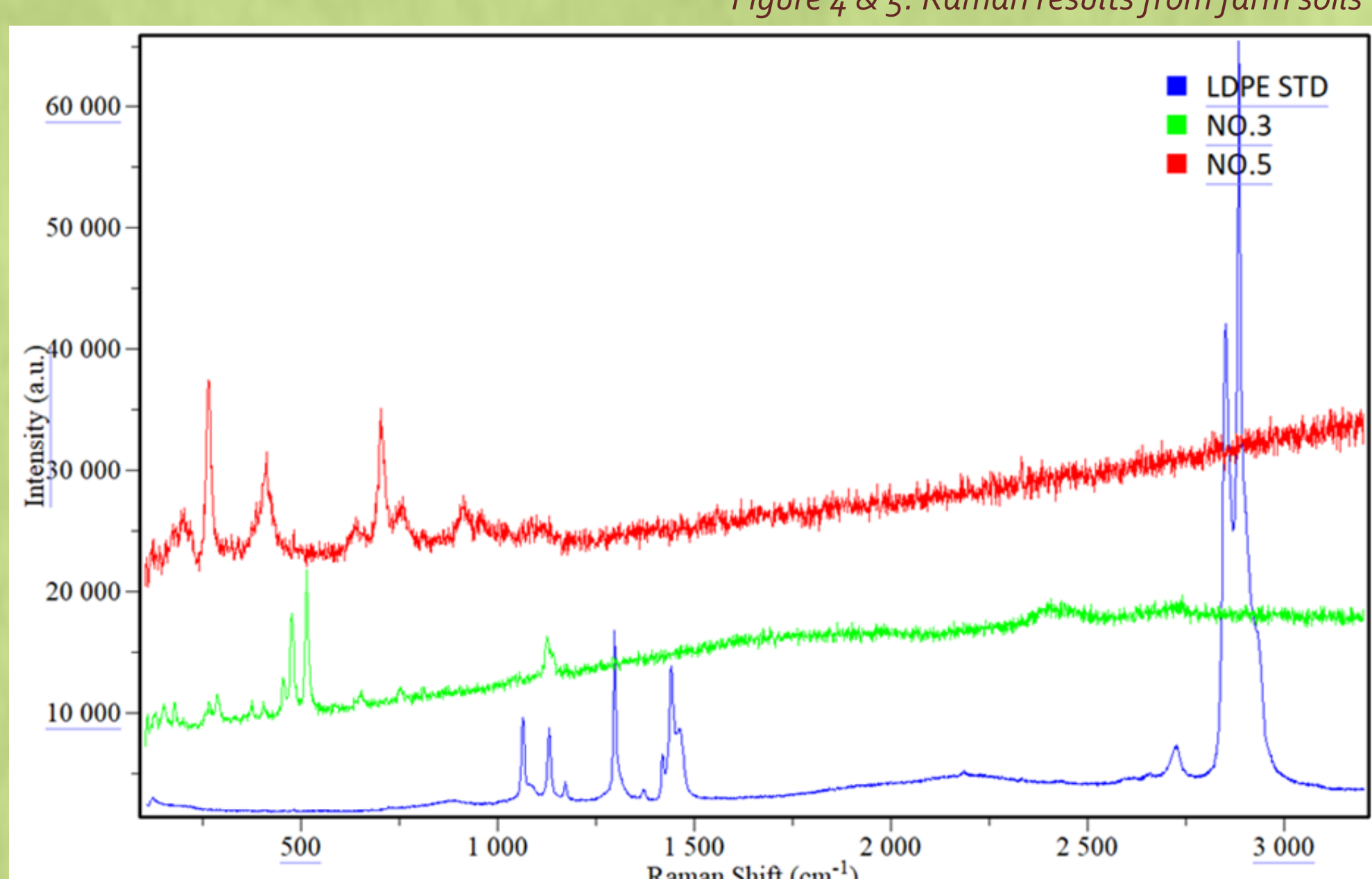
Figure 8: MP particles extracted from garden soil

Over 15 particles were isolated from 50G after only one separation cycle of the garden soil (sample 1 shown). The MP concentration of these soils was much higher than the agricultural soils. Over 50 particles were retrieved from the 50g sample. Over 35 were MP which translate t



Figure 7: This plastic was found approx. 9 cm below the surface and was 2mm in length.

Figure 4 & 5: Raman results from farm soils



Above and below are Raman spectroscopy results for samples 1 and 2 of farm soil respectively, the blue line is a standard piece of LDPE. There is a lot of noise surrounding the green and red lines indicating that the spectroscopy is not easily identifying them as MP. This could be due to the dark colour or presence of dirt on the surface of the MP.

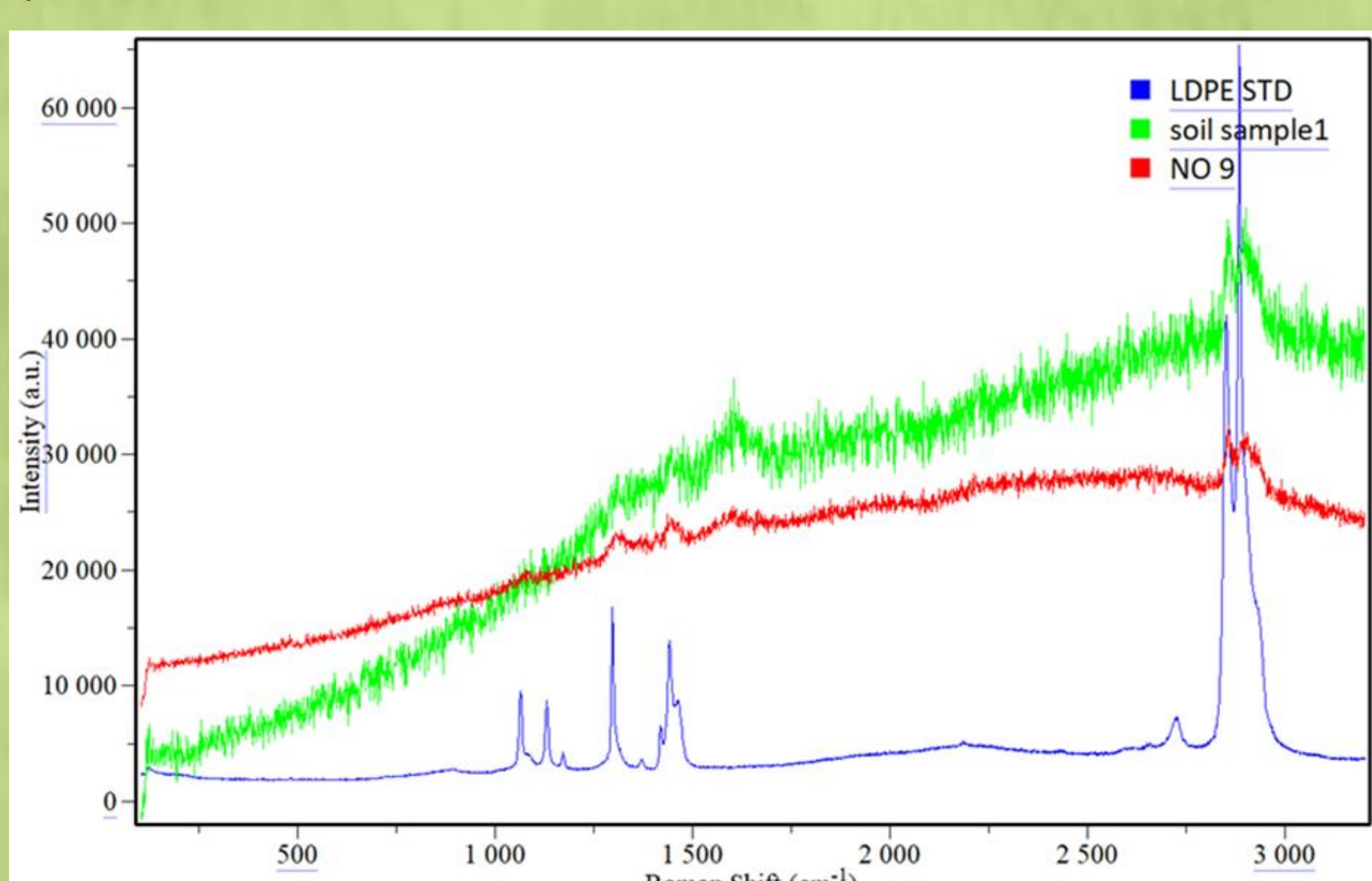


Figure 5

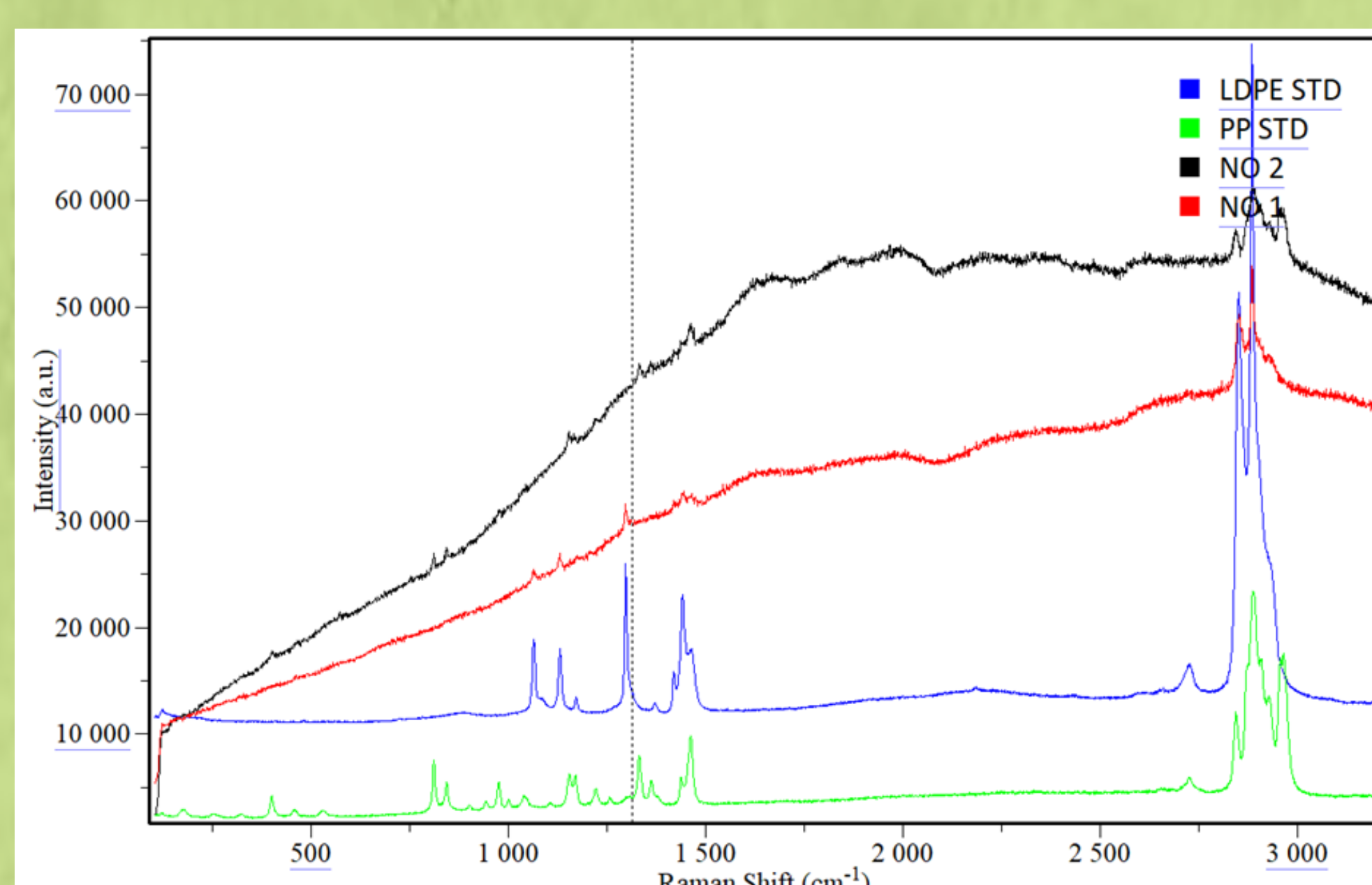


Figure 9: Raman results from garden soil, the lines are much smoother.

Particle No	Raman result	Particle No	Raman result
1	PE	10	No raman spectrum
2	PP	11	PP
3	PP	12	No raman spectrum
4	PE	13	PE
5	No raman spectrum	14	PE
6	No raman spectrum	15	PE
7	PP	16	PE
8	No raman spectrum	17	No raman spectrum
9	No raman spectrum		

Figure 10: Table of Raman results, 10 out of 17 particles were confirmed as polyethylene or polypropylene, the two most common MP.

Over 700 Microplastic particles per Kilo in garden soil.

Further work and research

This project proved challenging and rewarding. With meaningful and useful data there is huge scope for further work and research on this topic. Reducing the impact of MP is the next step.

Bioremediation is an exciting avenue in which one could reduce MP concentrations, this involves using microorganism to reduce MP concentrations in situ.

References

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