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B Pavan Kumar Naik
Department of Horticulture, Faculty of Agriculture, Annamalai University, Chidambaram, Tamil Nadu, India

D Saritha
Assistant Professor, Department of Agricultural Science and Rural Development, Loyola Academy, Secunderabad, Telangana, India

J Sam Ruban
Associate Professor, Department of Horticulture, Faculty of Agriculture, Annamalai University, Chidambaram, Tamil Nadu, India

Venkatraj
Department of Horticulture, Faculty of Agriculture, Annamalai University, Chidambaram, Tamil Nadu, India

M Nandinidevi
Department of Horticulture, Faculty of Agriculture, Annamalai University, Chidambaram, Tamil Nadu, India

Corresponding Author:
B Pavan Kumar Naik
Department of Horticulture, Faculty of Agriculture, Annamalai University, Chidambaram, Tamil Nadu, India

Microplastics in food and agriculture

B Pavan Kumar Naik, D Saritha, J Sam Ruban, Venkatraj and M Nandinidevi

Abstract
Microplastics (i.e., plastic particles < 5 mm in size) are an emerging environmental pollutant, increasing the number of microplastics viewed as a serious health concern in an ecosystem. Human exposure to microplastics is not a concern across ecosystems. During a daily intake of commonly consumed foods, we measured the amount of microplastics particles. Microplastics are also present in the water we drink. Some agricultural activities contaminate the soil, such as plastic mulching and packing materials. Living organisms in this ecosystem may be affected by microplastics present on soil surfaces that leach out to water bodies. Mankind is also affected by it. Agricultural farm wastes can be mulched on cultivable land to reduce microplastics contamination. These are easily decomposed in the soil, improving the soil surface's microbial population. Plastic is used to make fruit wrappers. Agricultural soils are sinks for microplastics particles that might have negative impacts on soil structure and organisms. The garbage is thrown into the streets of suburban neighborhoods. As a result of wind and human activity, these materials are easily shattered.

Keywords: Microplastics, food, agriculture

Introduction
Plastic production has been increased from 20th century approximately 8.7% per annum. Most of the plastics have been circulate in ocean surface water and soil. Unwanted plastic materials enter into the aquatic environment as trash, litter and industrial discharge through inside waterways and transport by winds (Smith *et al.,* 2018) [18]. Plastics have been created from several sources with fossil origin (crude oil, natural gas, etc.) or renewable materials (sugarcane, starch, vegetable oils etc.). When the plastics are exposed to environmental forces like sunlight, plastics will degrade into micro (nano) plastics. Microplastics are small plastic pieces < 5 mm long and recently identified in a extensive range of environments such as by way of soil, freshwater, ocean and organisms (He *et al.*, 2018) [10]. The level of degradation of plastic depends on varies factors like type of polymer, age and environmental conditions like temperature, irradiation, weathering and pH (Akbay and Ozdemir, 2016) [1]. Consequently, the worldwide contamination of microplastics will be ultimately brought back to our dinner table through consumption of numerous food items (Akoueson *et al.*, 2020) [2]. Though the plastics are made of synthetic organic polymers, they are classified into two types *viz.*, thermoplastics and thermoset resins (Geyer, 2020) [8]. 2500 Mt of plastics are currently in use and the cumulative plastic waste generation and disposal in 2010 to 2020 is 5000 Million metric tons to 7000 Million metric tons of primary waste generated. Existing manufacture and waste management tendencies continue, approximately 12000 Mt of plastic waste will be in landfills or in the natural setting by 2050 (Geyer, 2017) [9]. When the MP's are deposited on top soils, shattering occurs by solar UV radiation in addition to raised oxygen availability and temperature (Horton *et al.,* 2017) +. These shattered MP's can migrate vertically through soil profile and horizontally along the surface of soils, it may leads to spreads of contamination of plastic over a wide range including deep soil, groundwater and the aquatic ecosystems.

Procedures for extraction of Microplastics
Soil samples were treated with 30% H_2O_2 overnight to remove natural organic material, followed by filtration and second drying step. Filter papers were then saved in petridishes for further inspection and identification. A schematic diagram of analytical procedures for MP's extraction in soil samples is depicted in the Fig. 1 (Fakour *et al.,* 2021a) [5].

Floatation with NaCl solution for extraction of Microplastics

A density separation protocol has been developed due to MP's relatively light density. Saturated sodium chloride (NaCl) solution (1.18 g cm^{-3}) was used to isolate MP's from the soil matrix, through flotation. Each soil sample of 150 rpm for 5 minutes and stood at rest for 2 hours. MP's particles were floated on the surface of the suspension and the denser soil materials remained at the bottom of the solution gradient. The supernatant was filtered through a 500 µm stainless steel sieve an MP's larger than 500 µm were collected. The remaining filtrate was then filtrated by a 20 µm paper filter and MP's larger than 20 µm were collected. Same procedure was carried out at least twice for each sample until no materials were seen floating in the supernatant. The collected MP's were counted by hand and an additive oxidation digestion step required for the removal of the remained organic matter on the filter and the MP's. The two fractions of the isolated MP's were oxidized by 30% H_2O_2 for 2 days at 70 °C in a petridish, to be separated by organic matter particles with similar density, that remained after filtration shown in Fig. 2 (Isari *et al.*, 2021a) [12].

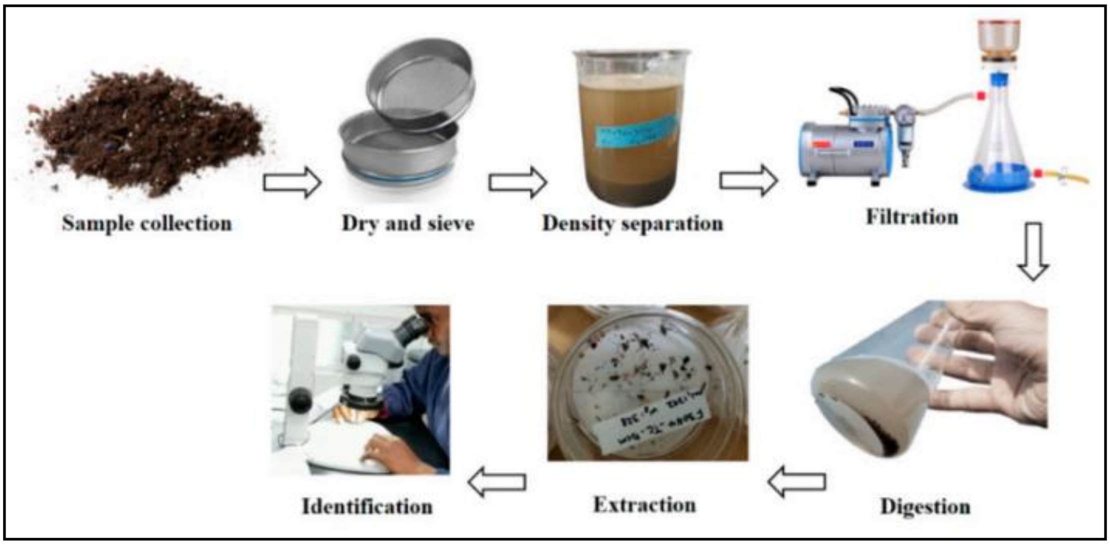

Fig 1: Schematic diagram in analytical procedure for MP's extraction in soil samples

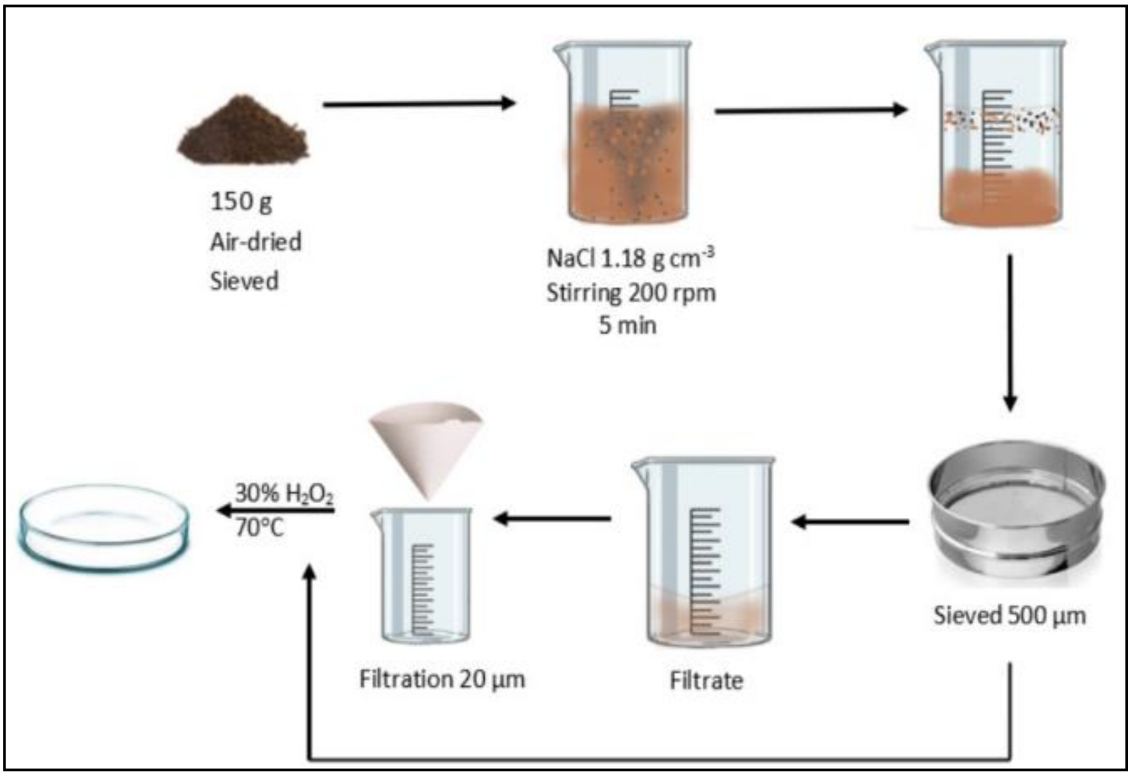

Fig 2: Schematic diagram of the MP's extraction by NaCl flotation

Study trends in effects of Microplastics in the soil environment

Soil is one of the most precious resources on Earth, providing a range of important ecosystem functions and services for humans and other organisms. Due to anthropogenic activities, like plastic mulching, sewage irrigation, soil amendment application, fertilizer coatings and littering and environmental media. Soil has become the largest reservoir of microplastics which may be 4 to 23 times that of the ocean shown in Fig. 3 (Yu *et al.*, 2020) [19]

By many farmer activities, many microplastics are added to agriculture soils. The most commonly used polyethylene plastics are *viz.*, Polyhouses as permanent cover materials, low tunnels to cover crops like watermelons, strawberries etc., for a short period; mulching sheets to control the soil temperature and moisture, to prevent irrigation water from evaporation and controls the weed growth braking; plastic drip irrigation tubes (Isari *et al.*, 2021b) [13] from five different cultivated fields of watermelon and canning tomato, soil samples are collected. In water melon fields (301±140 items Kg^{-1}), four times higher than in fields of canning tomatoes (69±38 items Kg^{-1}), finally proves that soils are contaminated with microplastics in agricultural activities.

Microplastics were found in all soil sample i.e., upper soil (top 5 cm) and lower soil (deep 20 cm) at different depths ranging from 12 to 117 items/m^2, with the mean concentration of 53.2 items/m^2 in upper soil and 34.3 items/m^2 in lower soil. The high amount of microplastics are found in suburban roads planted with guava where fruits are covered with protective foams and a plastic wrasp, which are shattered easily by wind and human activities. When exposed to solar UV rays and burrowed into the soil media leads to pollution in agriculture land shown in Fig. 4 (Fakour *et al.*, 2021b) [6].

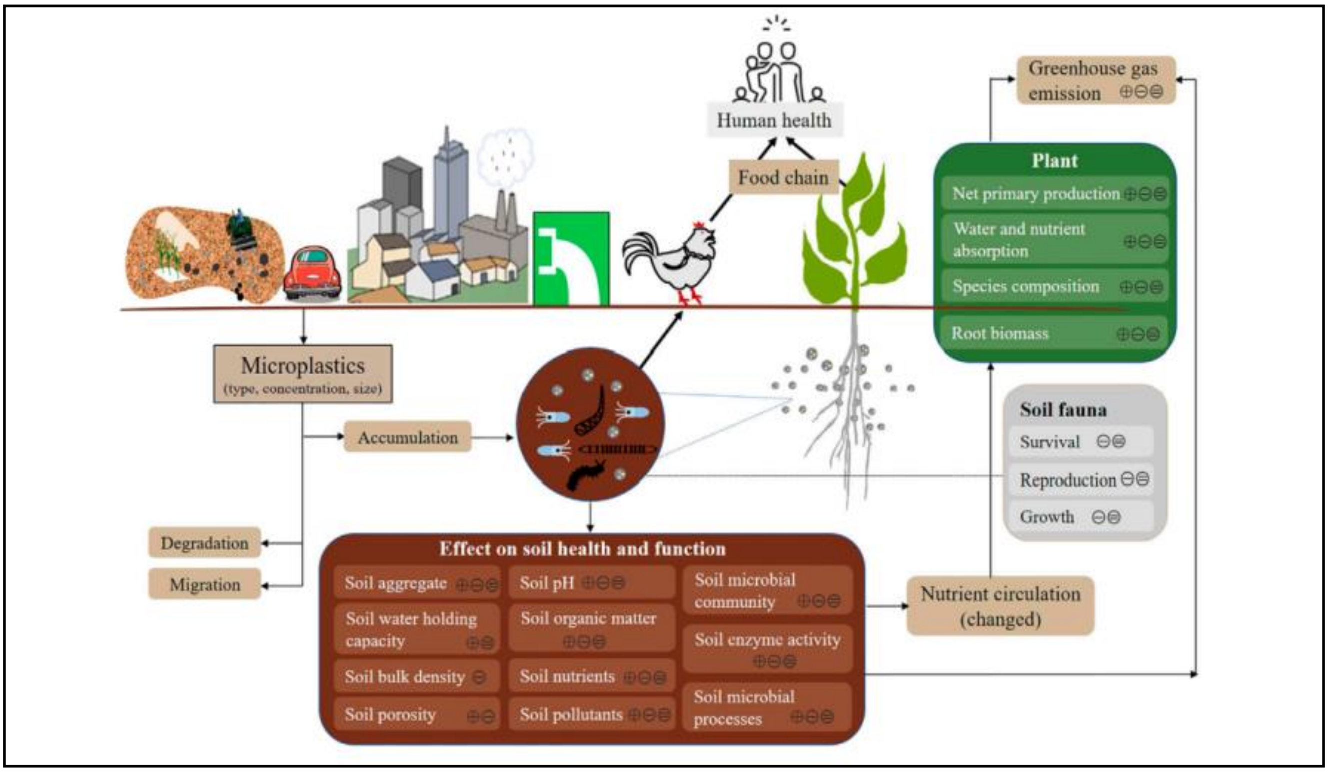

Fig 3: Sources of micrplastics in agricultural soils and their impacts on the ecological environment. The symbols of +, -, and = represents positive, negative and insignificant effects of Microplastics

Fig 4: Fruit packing expanded polyethylene foam net and plastic cover used for the package for the fruits in the suburban roadside Guava farm

Sources of Microplastics in Agriculture

Effects of microplastics on soil microorganisms and plants

Soil animals (Earthworms, mites, collembolan and nematodes) carries the microplastics into the soil. Physical and chemical properties of soils and plant growth may hinders by microplastics and heavy metals and pollutants. Pathogens adsorbes the pollutants and heavy metals on the soil surface which will shows the various effects on soil micro-flora (Leed and Smithson, 2019) [15]. Earthworms can ingest small sized plastics and generate secondary microplastics in their body besides they carry microplastics deep into the soil through their digging activities (Chae and An, 2018) [4]. Even nematode carry microplastics, soil dwelling nematode *Caenorhabditis elegans* exposed to low density polyethylene and a blend of polylactide and polybutylene adipate-co-terephthalate reduces the body length and reproduction (Schopfer *et al.,* 2020) [17]. Finally, high concentration of microplastics have shows severe effect on the growth, reproduction and survival of soil organisms (Kaur *et al.,* 2022) [14].

Microplastics could vary soil microbial groups affecting enzymatic activities and also affect nutrient and substrate availability likely due to absorption of microplastics or its competition for physicochemical niches with microorganisms (Fei *et al.,* 2020; Yu *et al.,* 2020; Lozano *et al.,* 2021) [7, 19, 16]. Soil pH along with microplastics chemical compounds into the soil may changes soil biota with significances for soil pH. Similarly, slightly microplastics films increased soil pH. (Fei *et al.,* 2020) [7] observed that polyethylene films may alter the diversity of nitrogen fixation bacteria taxa in the soil. Some studies says that adsorption of nanosized plastic beads has been found to hinder algal photosynthetic activities possibly through the physical blockage of light and air flow by the nanoparticles and promote their ROS production (Bhattacharya *et al.,* 2010) [3]. Interactions between microplastics and algae and physical damage may be the possible reason for toxic effects of microplastics on algae. Microplastics size could influence the toxic effects of microplastics on microalgae. Higher concentration of mPVC (microplastics pure polyvinyl chloride) shows a negative effects on algal photosynthesis since both chlorophyll content and photosynthesis efficiency decreased under mPVC (Zhang *et al.,* 2016) [20].

Conclusion

Referring to a few articles, observed a greater amount of microplastics entering the environment and food material by using the plastics in various ways *i.e,* plastic mulching in agriculture land, using plastic ropes as staking, plastic fruit covering and also damage the soil ecosystem, though plastic plays a key roles in agriculture. Slowly the microplastics are enter into food material and after intake of food by the human may cause various effects on health.

Reference

1. Akbay IK, Ozdemir T. Monomer migration and degradation of polycarbonate via UV-C irradiation within aquatic and atmospheric environments. Journal of Macromolecular Science. 2016;53(6):340-5.
2. Akoueson F, Sheldon LM, Danopoulos E, Morris S, Hotten J, Chapman E, *et al*. A premilinary analysis of microplastics in edible versus non-edible tissues from seafood samples. Environmental Pollution, 2020;263:114452.
3. Bhattacharya P, Lin S, Turner JP, Ke PC. Physical adsorption of charged plastic nanoparticles affects algal photosynthesis. The Journal of Physical Chemistry C, 2010;114:16556-16561.
4. Chae Y, An YJ. Current research trends on plastic pollution and ecological impacts on the soil ecosystem. Environment Pollution. 2018;240:387-395.
5. Fakour H, Lo SL, Yoashi NT, Massao AM, Lema NN, Mkhontfo FB *et al*. Quantification and analysis of microplastics in farmland soils: Characterization, sources and pathways. Agriculture. 2021a;11:330.
6. Fakour H, Lo SL, Yoashi NT, Massao AM, Lema NN, Mkhontfo FB., *et al*. Quantification and analysis of microplastics in farmland soils: Characterization, sources and pathways. Agriculture. 2021b;11:330.
7. Fei Y, Huang S, Zhang H, Tong Y, Wen D, Xia. Response of soil enzyme activities and bacterial communities to the accumulation of microplastics in an acid cropped soil. Science of The Total Environment, 2020;707:135634.
8. Geyer R. Production, use and fate of synthetic polymers, in: T. M. Letcher (Ed), Plastic Waste and Recycling, Academic Press London; c2020. p. 13-22.
9. Geyer R, Jambeck JR, Law KL. Production, use and fate of all plastics ever made. Science Advances. 2017;3:e1700782.
10. He D, Luo Y, Lu S, Liu M, Song Y, Lei L. Microplastics in soils: analytical methods, pollution characteristics and ecological risks. TrAc Trends in Analytical Chemistry, 2018;109:163-172.
11. Horton AA, Walton A, Spurgeon DJ, Lahive E, Svendsen C. Microplastics in freshwater and terrestrial environments: evaluating the current understanding to identify the knowledge gaps and future research priorities. Science of the total environment, 2017;586:127-141.
12. Isari EA, Papaioannou D, Kalavrouziotis IK, Karapanagioti HK. Microplastics in agricultural soils: A case study in cultivation of watermelons and canning tomatoes. Water. 2021a;13:2168.
13. Isari EA, Papaioannou D, Kalavrouziotis IK, Karapanagioti HK. Microplastics in agricultural soils: A case study in cultivation of watermelons and canning tomatoes. Water. 2021b;13:2168.
14. Kaur P, Singh K, Singh B. Microplastics in soil: Impacts and microbial diversity and degradation. Pedosphere, 2022;32(1):49-60.
15. Leed R, Smithson M. Ecological effects of soil microplastics pollution. Environment. 2019;30(3):70-84.
16. Lozano YM, Aguilar-Trigueros CA, Onandia G, Maa S, Zhao T, Rillig MC. Effects of microplastics and drought on soil ecosystem functions and multifunctionality. Journal of Applied Ecology. 2021;58:988-996.
17. Schopfer L, Menzel R, Schnepf U, Ruess L, Marhan S, Brummer F, *et al*. Microplastics effects on reproduction and body length of the soil-dwelling nematode Caenorhabditis elegans. Front Environment Science, 2020;8:41.
18. Smith M, Love DC, Rochman CM, Neff RA. Microplastics in seafood and the implications for human health. Current Environment Health Reports, 2018;5:375-386.
19. Yu H, Fan P, Hou J, Dang Q, Cui D, Xi B. Inhibitory effect of microplastics on soil extracellular enzymatic activities by changing soil properties and direct adsorption: an investigation at the aggregate-fraction level. Environment Pollution. 2020;267:11554.
20. Zhang C, Chen X, Wang J, Tan L. Toxic effects of microplastics on marine microalgae *Skeletonema costatum*: Interactions between microplastics and algae. Environmental Pollution, 2016, 1-7.