Influence of Oil Pollution on Soil Water and Fertilizer Coordination Ability

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Abstract. The soil guarantees the normal growth and development of the plant by coordinating the nutrition and environmental conditions such as water, fertilizer, gas, and heat. However, once the soil is polluted by oil, its own ability to coordinate water and fertilizer will inevitably be affected, thereby affecting plant growth. Therefore, it is proved that the impact of oil pollution on the coordination ability of soil water and fertilizer is the basic prerequisite for the reuse and restoration of contaminated soil. This article can provide basic guidance for the use and remediation of contaminated soil.

1. Introduction
Oil is the blood of modern industry and controls the economic lifeline of the entire country. However, with the development of the economic society, oil pollution has caused serious harm to the soil, water and atmosphere. The reason why soil is the irreplaceable basis of plant production is that it provides stable, uniform, sufficient and suitable nutrition and environmental conditions for plants. Scholars have also conducted a lot of research in this area. But the heterogeneity of water and fertilizer coordination ability of polluted soil, especially organic polluted soil is not enough. Therefore, it lacks the theoretical support of its feasibility and utilization method in agricultural and ecological construction. It is proved that the impact of oil pollution on the coordination ability of soil water and fertilizer is the basic prerequisite for the reuse and repair of contaminated soil. This article summarizes and analyzes the research progress of oil pollution affecting soil water and fertilizer coordination, which can provide basic guidance for the follow-up related research work and the use and remediation of contaminated soil.

2. The effect of oil pollution on plant growth

2.1. Status of oil pollution
With the rapid development of the oil industry, the development and use of oil and its products are increasing. Oil pollution has a large number of negative effects on the soil ecosystem, and the
ecological environment carries a huge pollution load [1-2]. According to relevant literature, the world's average annual oil production is about 4 billion tons, and an average of 2 kg of pollutants enter the environment for every 1 t of oil produced. About 8 million tons of oil pollutants enter the environment each year. It enters the soil and causes harm to its quality. There are currently more than 400 oil and gas fields explored and developed in China, accounting for about 3% of the country’s total land area, of which about 48,000 km² of land may have petroleum hydrocarbon content that exceeds safety thresholds. At present, China's annual oil production has exceeded 180 million tons, of which nearly 600,000 tons of crude oil have directly entered the environment because of the unrecoverable, and about 100,000 tons of oil-contaminated soil is added every year. The soil environment is facing great security risks, and it is urgent to explore the relevant theoretical basis and technical system for the utilization and remediation of oil-polluted soil. Problems such as the degree of harm, damage mechanism, and remediation technology and effects of oil pollution on soil and plants have always been difficult problems faced by scientists and an important subject dedicated to research. Although fruitful results have been achieved, many scientific problems are still urgently needed to be studied.

2.2. Effect of oil pollution on plant growth
Due to the different degree of pollution, the impact and harm of oil on soil and plants are also different, and the degree of damage to soil quality and plant growth and its mechanism are also different at different stages. At the beginning of the pollution, the soil pores are mainly blocked, affecting the permeability of the soil, and changing the quality of the soil pores and the composition and structure of the soil organic matter. Oil will adhere to the root surface, corrode the root system, affect the absorption of water and nutrients by the root system, and cause the plant to die due to lack of water and fertilizer. In addition, the volatile gas in the oil occupies the pores of the soil, suffocating the plant root system under hypoxia. Although the degree of harm is strong in the initial stage, the process is short, and people's cognition is relatively clear. However, when petroleum pollutants are fixed by the soil and the state has stabilized, the mechanism of pollutants affecting soil quality and crop growth is still lacking a clear understanding.

The hazards of oil on soil properties [3-4], plant growth [5-7], ecological environment and human health are indisputable [8-10]. However, some scholars in the academic community have recently put forward some contrary views, which directly impact people's inherent cognition. The study believes that petroleum, as a carbon-containing organic substance, is not only harmless but beneficial in the soil. Planting alfalfa with soil contaminated with oil-containing drilling fluid does not show harm, but instead increases the yield of alfalfa significantly, compared with the control treatment without pollution 21.6%, the quality of alfalfa has also been significantly improved [11]. Although the stable oil pollutants have obvious effects on the soil properties, they can also meet the germination and growth needs of some forage crops. There are certain differences in the levels of oil pollution that different forage species can tolerate [12-14].

3. Influence of oil pollution on soil water and fertilizer coordination

3.1. Influence of oil pollution on soil water coordination ability
The soil uses a colloidal system with rich surface area, huge surface energy and charge structure as the material basis, a stable structure formed by multi-level reunification as the state basis, and a powerful reciprocating "internal biological circulation system", etc. Temperature, air, nutrients, acid and alkali, and redox and other nutritional and environmental conditions, buffering the badly changing natural environment, so as to ensure the normal growth and development of plants. The soil has a rich surface area, huge surface energy, a colloidal system of charge structure, a multi-level reunion stable structure, etc., which always coordinates the environmental conditions such as moisture, temperature, air, nutrients, acid and alkali, and redox, thus ensuring plants growth and development. However, once the soil is contaminated, especially organic pollution, the pollutants will inevitably modify the surface of the soil, mask the functional sites, change the type and quantity of soil particle charge, etc., thus
affecting the soil colloid's absorption of water and nutrients, and affecting ions Exchange mechanism. Hydrophobic organic pollutants will change the hydrophilicity of the particle surface and block the pores of the soil, thereby affecting the capillary conduction of the substance in the soil. Regrettably, similar theoretical mechanisms have so far lacked sufficient scientific experimental support.

Soil moisture is the most important among many fertility factors. Once the soil is contaminated, the mechanism of soil water movement will be affected. Scholars have achieved fruitful results in the study of soil moisture availability and transmission mechanisms [15-16]. However, there are relatively few studies on the impact of organic pollutants represented by oil on soil moisture. At present, much research work is basically concentrated on the evaluation and remediation of the status of oil-polluted soil [17-18]. Although a few scholars have studied the effect of oil pollution on soil moisture characteristics, they have also focused on the approximate acquisition of soil moisture permeability, wettability, hydraulic conductivity and related parameters [19-20]. Only a few researchers have evaluated the effects of kerosene and diesel on the hydrodynamic properties of loamy soils, pointing out that pollution changes the soil’s water-holding properties, leading to a decrease in the soil’s saturated moisture content and residual moisture content [20]; gasoline changed the hydraulic conductivity of bentonite, kaolin and quartz sand, which caused the hydraulic conductivity of the three to decrease with the increase of pollution [21]; the saturated hydraulic conductivity of soil contaminated by compactor oil also decreased significantly [22]. However, the above research on the impact of oil pollution on soil moisture, some of which use diesel distillate, gasoline, motor oil and other petroleum distillate components as research materials, and some use quartz sand to simulate contaminated soil, and most of them focus on the apparent influence.

At present, there are a few reports on the study of oil pollution on soil water transport and the mechanism of regulation and control. Some studies have pointed out that oil pollution has caused a change in the wettability of the soil surface and caused a significant decrease in soil capillary force [23]. Drip penetration test shows that diesel pollution caused a significant increase in water repellency of forest soil [24]. However, the existing research work is still not systematic enough, and the selected soil texture category is relatively single, and it is not possible to fully clarify the mechanism of the influence of oil pollution on soil water migration from the microstructure.

3.2. Effect of oil pollution on the coordination of soil fertility

Nutrient is one of the important indicators of soil fertility. The soil's ability to retain nutrients, exchange and coordination is an important parameter to measure soil quality. Relying on the electric double layer structure of soil colloid to realize the exchange of ions is not only the foundation of soil stabilizing fertilizer, but also an important mechanism to coordinate the supply and demand balance between ions. Some researchers have better regulated soil nutrients by applying poultry manure litter to the soil [25]; long-term application of low-carbon nitrogen fertilizers has a significant effect on soil nutrient pool regulation and crop yield improvement [26]. After alternating wet and dry treatment, the physical and biological properties of the soil change, thereby regulating the soil nutrient supply capacity [27]; plant allelopathy can also increase the availability of soil nutrients and play a positive role in wheat growth [28]. In arid tropical regions, seabuckthorn effectively prevents soil erosion, enhances soil moisture availability, and enhances soil nutrient retention capacity, which is of great significance to plant growth [29]. It can be seen from the above research that scholars are devoted to the study of soil nutrient regulation and storage capacity, and have obtained some valuable research results, but their research objects are mostly concentrated on conventional clean soil. At present, there is still little research on the effect and mechanism of pollutants on soil nutrient regulation ability.

4. Conclusion

In summary, the barrier that severely restricts the use of oil-contaminated soil is mainly the lack of knowledge of the water and fertilizer supply and coordination capabilities of the contaminated soil, and its mechanism of action is not yet clear. In the face of the theoretical development of environmental disciplines and the urgent need for oil-polluted soil utilization and remediation
technologies, there is an urgent need to carry out breakthrough research on the ability of organic pollutants represented by oil to coordinate soil moisture, nutrients and their impact mechanism. Thereby this article can enrich the research theories of organic pollutants represented by oil on the regulation of soil water and fertilizer, and provide an effective scientific basis for the evaluation, management and utilization of organic polluted soil pollution, and the use of remediation.

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