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ASSESSMENT OF THE IMPACT OF OIL AND OIL PRODUCTS ON THE ENVIRONMENT AND LIVING ORGANISMS

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Abstract. Phytotoxic properties of Absheron soils were studied when they were contaminated with oil and oil products. For this purpose, samples were taken from gray-brown semi-desert soil from Binagadi settlement of Absheron region and light chestnut soil from Saray settlement. Studies conducted with these soil types have shown that arid areas are not resistant to pollution by oil and oil products in terms of phytotoxicity. It was found that the soils of the Absheron peninsula contaminated with oil and oil products have a negative effect on the growth and development of test plants.

Keywords: *Environment, oil pollution, phytotoxic properties, biomass, toxic substances.*

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1. Introduction

Extraction of minerals, including oil, their processing and transportation is a factor that seriously affects the condition and fertility of the Earth's soil cover, it is already one of the accepted realities of today. So that, the fall of oil and oil products into the soil changes all the biochemical processes that occur naturally there and causes it to be re-formed on other grounds and it realizes the occurrence of serious changes in the character of the existing trophic relationships and the structure of the soil. Since the changes occurring are not only quantitative, but also qualitative, sometimes the effect of these changes results in the complete loss of soil functions and unfortunately, it should be noted that such a situation is typical for the Republic of Azerbaijan (Aliyeva, 2006; Abdulova, *et al.*, 2005) It is no secret that soil fertility plays an important role in obtaining abundant crops and in oil-contaminated soils, this main indicator has low quantitative indicators. On the other hand, the toxic nature of the oil itself has a serious effect on the volume of the product to be taken from it (Khalilov *et al.*, 2010; Aliyeva, 2004; Nasibova, 2020).

From the data on the changes in the structure of the mycocomplex characteristic of clean soils due to the influence of oil pollution, it is clear that the species composition of many fungi is expanding and dominant species are recorded in man-made soils (Aliyeva, 2020; Agayev *et al.*, 2004; Korneykova *et al.*, 2011). Although such a situation is not typical for clean soils, many species with confirmed pathogenicity are among the most frequently observed fungi in soils after oil pollution. Then the question arises, does the

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proliferation of this type of fungi due to the effect of oil pollution have an effect on the phytosanitary condition of the soil? If such an effect exists, determining its nature is of both scientific and practical importance.

Oil products toxic to plants are hydrocarbons with a boiling point of 150-275° C, that is, white oil and naphthenic fractions. Less toxic or generally harmless are petroleum products with lower boiling points, especially their volatile fractions, because they evaporate before they have time to penetrate the soil solution and as a result, plant tissue.

The harmful effect of heavy fractions of oil is related to the clogging of pores and channels of the soil, through which the exchange of substances between the soil and the surrounding environment takes place. A mechanical barrier is created between the plant and the environment, which complicates the water, air and nutrient regimes of plants. Chemical toxicity of oil and oil products is not always obvious in relation to biological test objects. It is known that a small amount of oil in some cases even has a stimulating effect on the growth and development of some plants (Nasibova, 2019; Nikitskaya, 2008; Orlova *et al.,* 1997; Kireeva *et al.,* 2021).

Thus, for example, Adam and Duncan (1999) came to the following conclusions as a result of their research: legumes and some cereal grasses that are lowly polluted with diesel fuel (25g/kg) remain almost unaffected, the study at the pollution level of 50g/kg half of the 22 types were 50% behind the norm. When the soil is contaminated with oil and oil products, the length of wheat shoots, seedling mass and root length are 6, 12 and 16% compared to the control samples. The inhibitory effect of oil on the growth and development of plants is related to the disturbance of the ecological situation in the soil environment: changes in hydrothermal and weather regimes, physical and chemical properties and the combination of biogenic elements - phosphorus, nitrogen and potassium with oil. Most of the oil components, which are analogues of biotic hydrocarbons, can be easily absorbed by plants through the root system, thus creating a high level of their content in the biomass (Mammadova *et al.*, 2022; Nasibova *et al.*, 2021; 2016; Maleki *et al.*, 2021; Kokanina *et al.*, 2010).

The more toxic substances are in the atmosphere, the more they accumulate in the soil and plants (Kireeva *et al.*, 1996; Nazarov *et al.*, 2000; Sangadzhieva *et al.*, 2013; Nasibova *et al.*, 2013). Currently, there are many works devoted to the study of the phytotoxic properties of oil-contaminated soils (Ekundayo *et al.*, 2001; Khalilov *et al.*, 2018; Koronelli, 1996; Buluktaev, 2017). However, there are not many studies on the effect of oil-contaminated soils on the growth and development of plants in these areas.

2. Materials and methods

Studying the phytotoxic properties of Absheron soils when they are contaminated with oil and oil products was taken as the main goal of the research work. In accordance with the purpose, the following tasks were defined: selection of soil samples; conducting model experiments, investigating the effect of oil and oil products on the growth and development of the test object plant. Soil samples for the model experiments were taken from clean background areas away from roads, pipelines and power lines.

Materials - experimental samples were taken from gray-brown semi-desert soil from Binagadi settlement , light chestnut soil from Saray settlement of Absheron district.

Soil samples were taken from the top 10 cm layer, dried to bare state and sieved through a 3 mm mesh. The main characteristics of the investigated soils are shown in the table. 10 g of pea seeds were sown in each growing container. Throughout the experiment,

the temperature was maintained at 22 o C±10 o C, optimal humidity 60%±25%, 16 hours of sunlight (the climatic conditions of the region allow not to use additional lighting).

Table 1. Physico-chemical and biological properties of Absheron soils

The type of soil	Granulometric composition	Hummus, %	pH	Summarized N	P2O5	K_2O	Catalase activity, ml O_2/g
				mg/100 g			
Gray-brown semi-desert	Sandy clay	1,0	8,4	1,1	1,74	25,3	2,36
Light chestnut	Medium clay	1,5	8,7	1,5	3,58	36,1	7,13

Gray-brown semi-desert and open chestnut soil samples were placed in vegetation containers (plastic boxes size 50x15x10). Soils weighing 5 kg (dry weight) were moistened with 60% distilled water.

10 g of pea seeds are planted in each vegetation container. The surface part of the soil is polluted. Density of oil and oil products is 2.5; 5 and 10%. The temperature was maintained at 22°C ±10°C throughout the experiment. Optimal humidity was 60%±25%, 16 hours of sunlight (the climate of the region allows not to use additional lighting methods) was applied. Soil phytotoxicity was analyzed by changing soil germination parameters and seedling initial growth intensity (root length, shoot length, total biomass).

Chickpea (Cicer arietinum L.) was used as a test sample. Exemplary experiments on oil-contaminated soils were conducted in laboratory conditions - in Petri dishes. The essence of the method is that the investigated gray-brown semi-desert and open chestnut soils were placed in Petri dishes with a 1 sm layer and the soils were moistened. 10 seeds of the researched test plants were planted in each Petri dish and irrigation was carried out if necessary. After 5-10 days, the germination of the seeds was evaluated according to the number of germinated seeds of the control seeds; shoot and root length and total biomass were studied in vegetation 1 month after the start of the experiment. Laboratory experiments were repeated three times.

3. Results and discussion

The phytotoxic effect of oil and oil products in gray-brown semi-desert soils in laboratory experiments is shown in Figure 1 and Table 2.

Oil pollution of the gray-brown semi-desert soil causes a decrease in germination, the length of roots and shoots, as well as the total biomass of plants. Thus, depending on the oil concentration (2.5%; 5% and 10%) of the oil - contaminated gray-brown semi-desert soils, a 42%; 60% and 82% decrease in germination is observed.

The length of the stem decreases by 2.5%, by 37% at the oil dose and by 71% at the maximum oil concentration (10%). The length of the roots decreases by 4.5 times compared to the control. In the experiment, the total biomass of plants is reduced to 15%.

Contamination of gray-brown semi-desert soils with oil and formation waters causes a sharp deterioration of soil properties due to the high acidity of formation waters. Thus, pea seeds did not germinate at 10% reservoir water concentration of oil, 72% of pea at 5% oil dose, 2.5% pollutant in soil decreased, germination decreased by 57% in control.

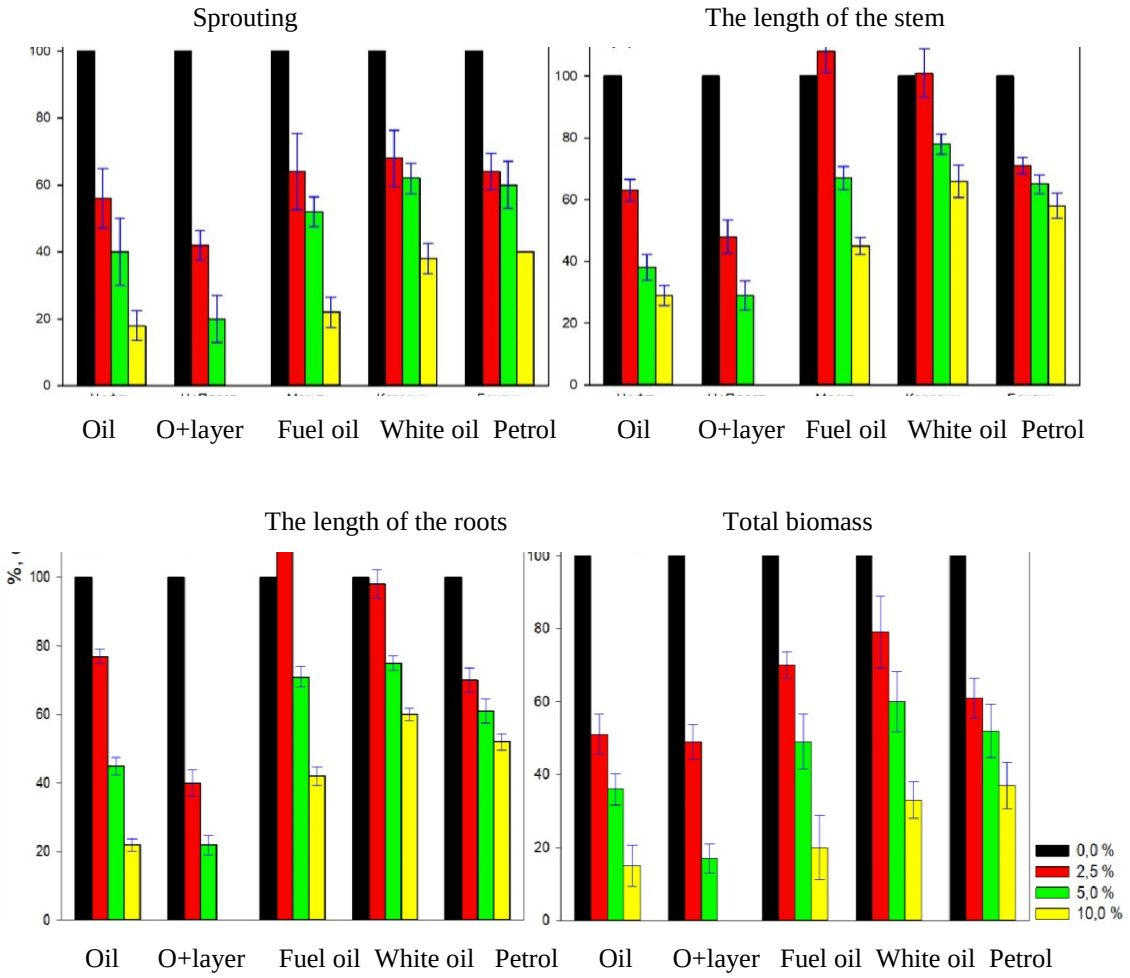

Figure 1. Effect of pollution with oil and oil products on the phytotoxic properties of gray-brown semi-desert soil

In addition, the studied pollutant significantly inhibits the growth and development of pea seedlings, the length of the stems is reduced by 2.5 and 4.5 times compared to the control. The total biomass pollutant was reduced by 83% compared to the control, even at a concentration of 5%. Fuel oil formation water causes less obvious changes to the properties of gray-brown semi-desert soils than oil and oil products.

Thus, oil pollution at low concentrations caused growth stimulation of pea plants. Germination at 2.5%, 5% and 10% doses of fuel oil is 63; 53 and 23%, respectively, compared to the control. At 2.5% fuel oil concentration, the length of stems and roots is slightly stimulated and inhibited by 5% and 10% fuel oil doses. Total plant biomass was reduced by 30%, 51% and 80% compared to the control.

Gray-brown semi-desert soil pollution with different doses of white oil, as a rule, decreases all the studied parameters, but at a white oil concentration of 2.5%, the length of the stems is practically the same as that of the control samples and even slightly exceeds it. With this type of pollution, the germination of plants is reduced by 32%, 39% and the reduction of stems and roots by 62%, the maximum concentration of white oil is 40% of the control. The total biomass of chickpea was reduced by 1.1% when

contaminated with white oil, compared to 1.6 and 3.0 times compared to uncontaminated samples.

Table 2. Phytotoxic properties of gray-brown semi-desert soils under the influence of oil and oil product pollution

The dose of the pollutant, %	Germination	Stem length	Root length	Total biomass
	By control, %			
Modeling oil pollution				
0	100	100	100	100
2,5	58	63	77	51
5,0	40	38	45	36
10,0	18	29	22	15
HCP_{05}	*8*	*9*	*8*	*10*
Modeling of oil contamination by reservoir water				
0	100	100	100	100
2,5	43	48	40	49
5,0	28	29	22	17
10,0	0	0	0	0
HCP_{05}	*11*	*10*	*12*	*11*
Modeling of fuel oil pollution				
0	100	100	100	100
2,5	63	108	113	70
5,0	53	67	71	49
10,0	23	45	42	20
HCP_{05}	*9*	*13*	*12*	*8*
Modeling of white oil pollution				
0	100	100	100	100
2,5	68	101	98	89
5,0	61	78	75	60
10,0	38	66	60	33
HCP_{05}	*9*	*9*	*8*	*9*
Petrol Pollution Modeling				
0	100	100	100	100
2,5	64	71	70	61
5,0	60	65	61	52
10,0	40	58	52	37
HCP_{05}	*8*	*10*	*9*	*8*

Gasoline also causes a decrease in all studied plant parameters. In germination gray-brown semi-desert soils, the movement of different doses of gasoline decreases and is

36%, 40% and 60%, respectively, compared to the control. The length of the stems is reduced by 1.4% from the control variant, the length of the roots is reduced by 52%. The total biomass of test plants decreased by 39%, 48% and 63% when soils were contaminated with gasoline at 2.5%, 5% and 10% doses, respectively.

Thus, pollution of gray-brown semi-desert soils with oil and oil products, as a rule, leads to a significant deterioration of soil properties. The most negative phytotoxic effect on test plants is observed in soils contaminated with groundwater and oil. Contamination of gray-brown semi-desert soils with oil and fuel oil is similar with phytotoxic effects on studied plants. Soil pollution with white oil and gasoline has a similar effect.

Compared to the control, seed germination was reduced by 1.6, 2.2 and 3.4 times in oil-contaminated open-chestnut soils of Saray settlement. The length of shoots decreased by 69, 53 and 41% compared to the control, the length of roots decreased by 35, 47 and 59%. The total biomass of chickpea decreased up to 23%. Oil contamination of open-chestnut soils at a dose of 10% leads to complete loss of seeds. A contamination dose of 5% caused an 89% reduction in germination, while a 2.5% dose reduced germination to 37%.

4. Conclusion

As a result of the research, it has been proven that the soils of the Absheron peninsula contaminated with oil and oil products have a negative effect on the growth and development of test plants. It should be noted that the low concentration of white oil and fuel oil in the gray-brown semi-desert soils of Absheron shows a slight increase in the length of stems and roots in the plant. Thus, the studies conducted with two soil types of the Absheron Peninsula showed that arid areas are not resistant to pollution by oil and oil products in terms of phytotoxicity.

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